ANTHRACITE-COKE FACTORIES

NEW LOWE,
COKE and GAS SYSTEM

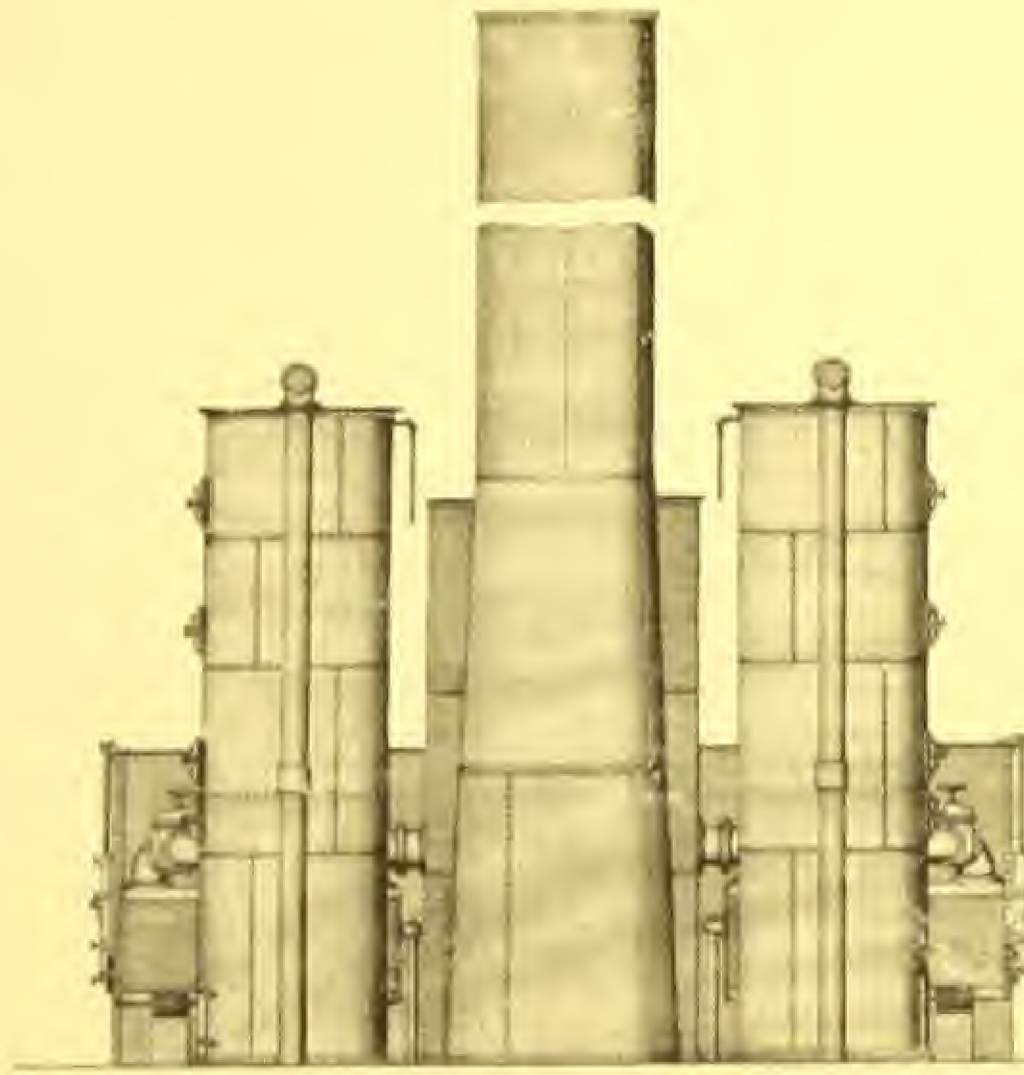
ANTHRACITE COKE

EXPERT REPORTS

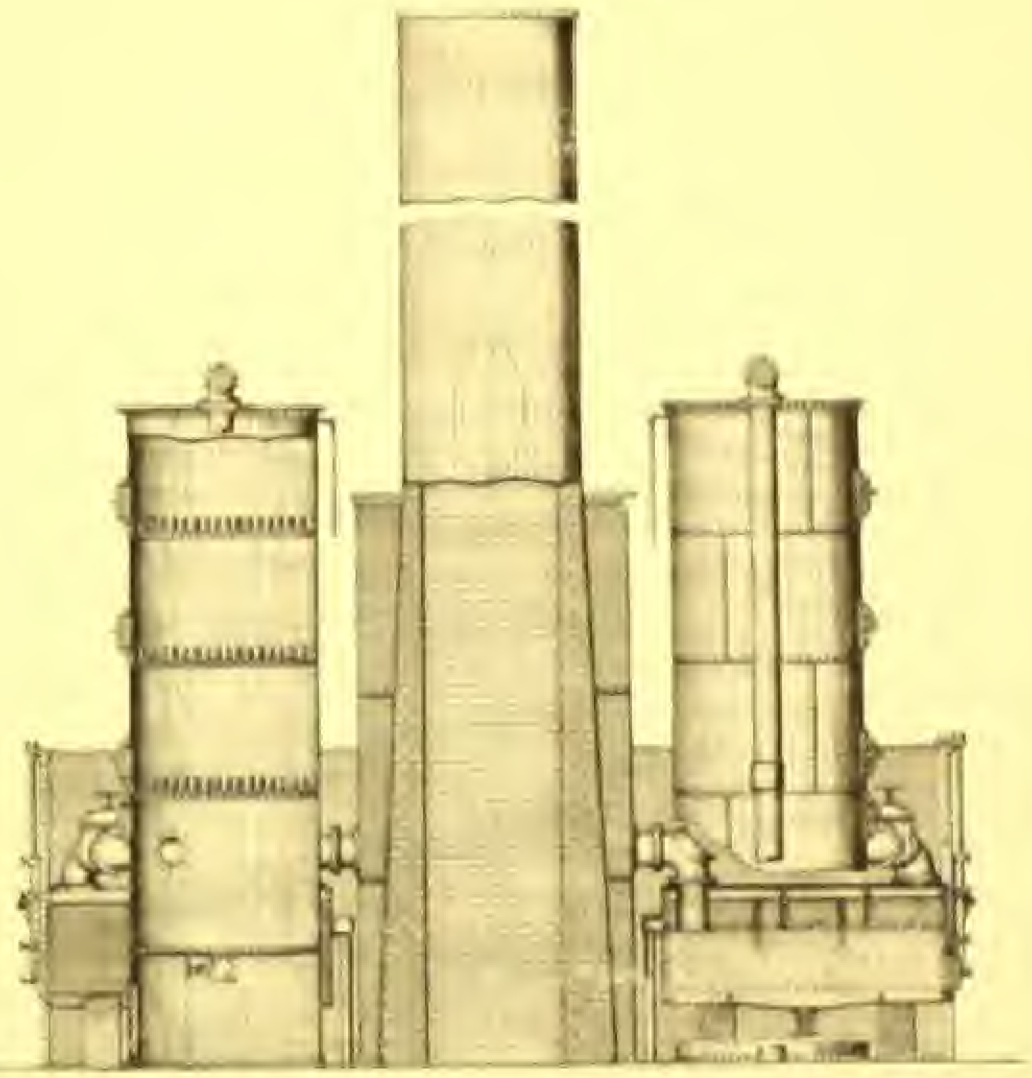
ON THE NEW

Lowe Anthracite Coke and Gas System

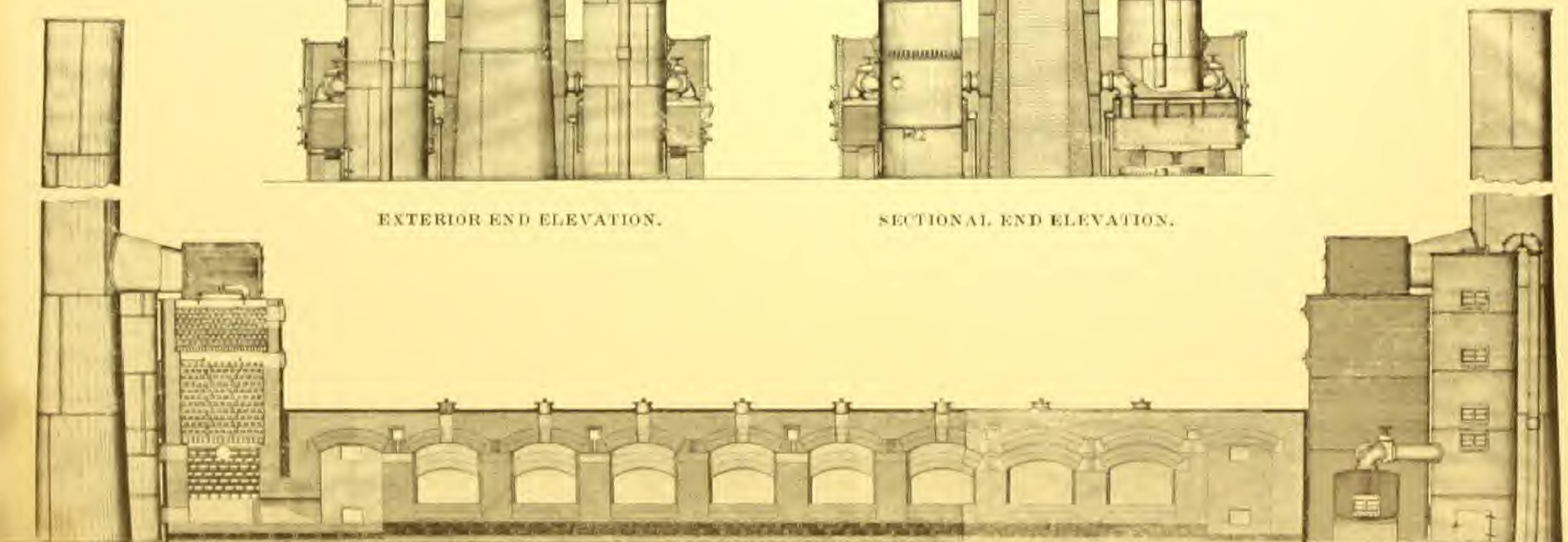
(1902)



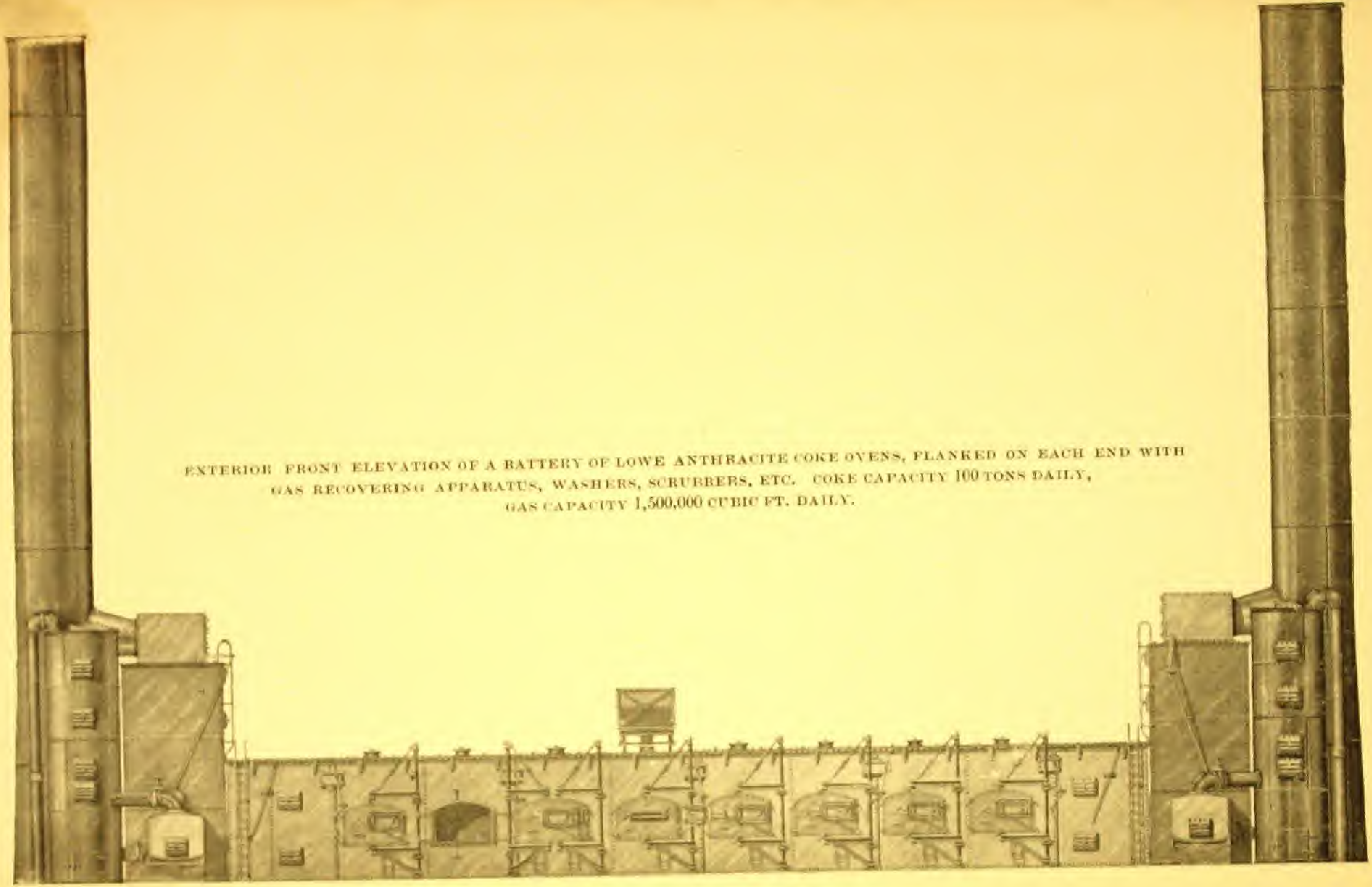
EXTERIOR END ELEVATION.



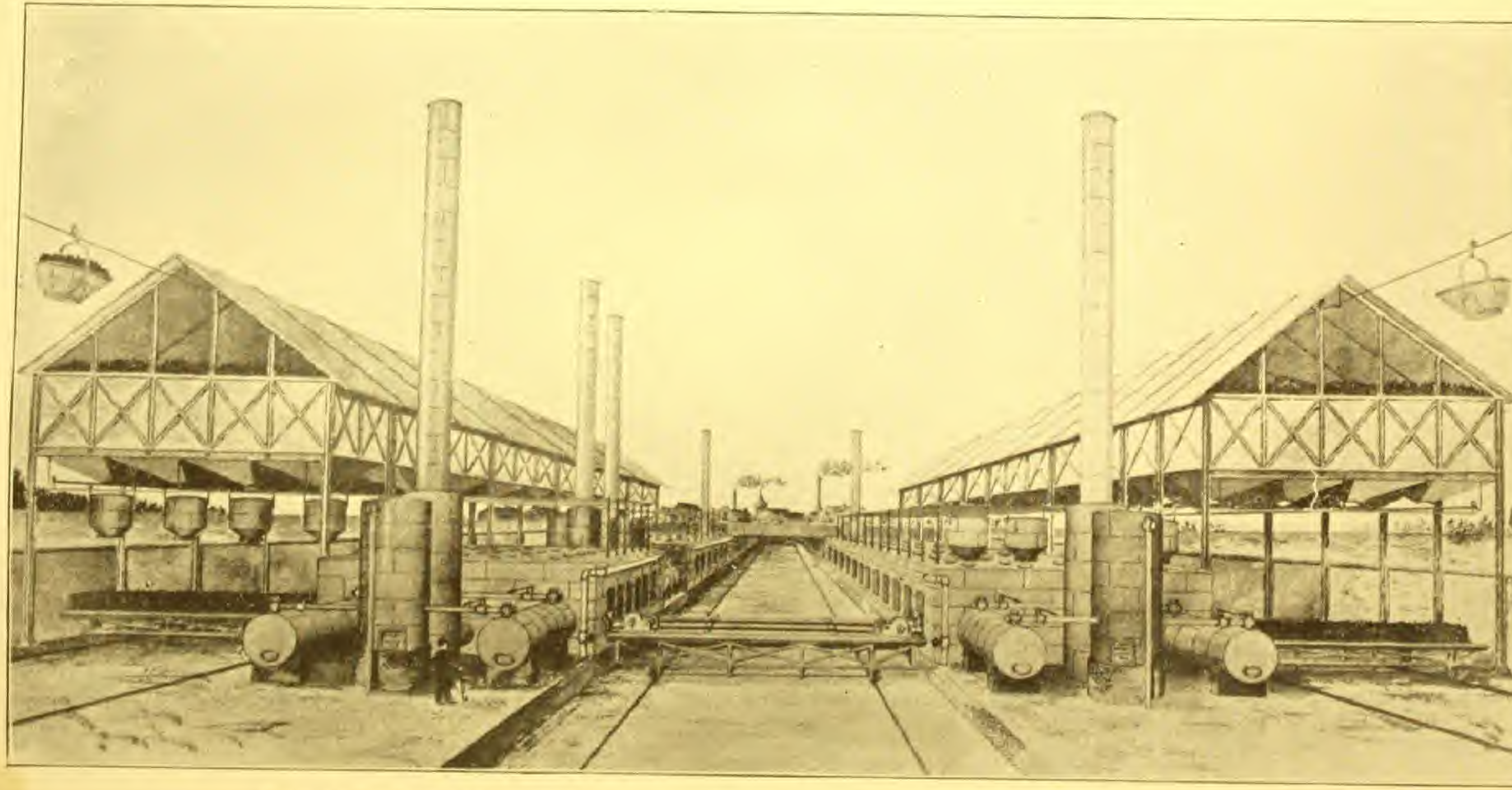
SECTIONAL END ELEVATION.



SECTIONAL ELEVATION OF BATTERY OF LOWE ANTHRACITE COKE OVENS, SHOWING STEAM GENERATORS, WITH STACKS AND GAS RECOVERING APPARATUS.

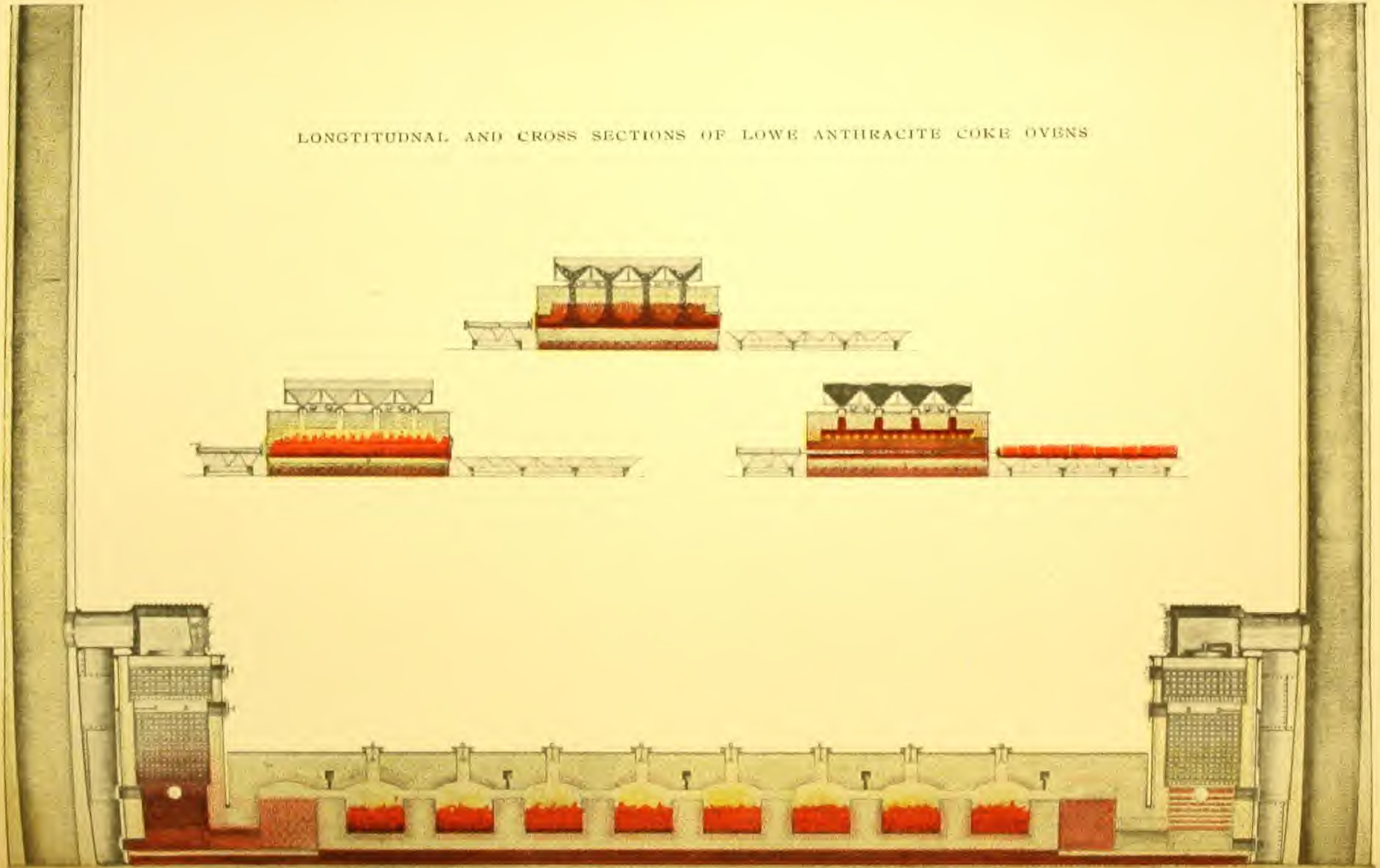


EXTERIOR FRONT ELEVATION OF A BATTERY OF LOWE ANTHRACITE COKE OVENS, FLANKED ON EACH END WITH GAS RECOVERING APPARATUS, WASHERS, SCRUBBERS, ETC. COKE CAPACITY 100 TONS DAILY, GAS CAPACITY 1,500,000 CUBIC FT. DAILY.



FIRST DESIGN FOR LARGE PLANT OF LOWE COKE OVEN, DISCHARGING RAM IN MIDDLE OF PICTURE.

LONGTITUDNAL AND CROSS SECTIONS OF LOWE ANTHRACITE COKE OVENS



Anthracite Coal Factories

What Nature Takes a Million Years to Accomplish, is now Done in Twenty-four Hours.

"The only effective way to abate a smoke nuisance is to provide a smokeless fuel at less cost."

The use of fuel the world over is most crude and not at all in keeping with the advancement made in other branches of arts and sciences. In the larger portions of the civilized globe, anthracite or hard smokeless coals are entirely unknown in practice, and of the coal fields of the United States but a fraction of them are anthracite. This coal, wherever obtainable, on account of its cleanliness and slower combustion, commands from double to four times the price of the best bituminous coal, according to location and cost of transportation. Only a few years ago, anthracite coal was extensively used in blast furnaces, but owing to the scarcity and increasing price, its use has been discontinued, coke being substituted.

A few months ago a carefully written article went the rounds of the scientific journals and the press of the country generally, pointing out the fact of the rapid exhaustion of the anthracite coal fields. The writer predicted that unless through invention a substitute was created, anthracite coal would disappear within fifty years. Evidently this writer had faith in inventions, but did not dream that the invention had already been perfected and by practical demonstrations had proven that a new kind of coke harder and better than that now known as coke and equal, if not superior to the best anthracite coal, suitable alike for all domestic and manufacturing purposes, could be made from most all bituminous coal and coal slack, or screenings, in twenty-four hours, that takes by nature, according to scientific calculation, a million or more years to accomplish.

Allowing this to be a fact, then to the world this invention is of far greater value and importance than all the anthracite coal fields on the globe put together. It enables every town and city not only to manufacture all its own domestic and metallurgical fuel of the very best quality, but while doing so, will produce the cheapest gas that can possibly be made, suitable alike for illumination, fuel and power purposes.

Engines for the use of gas as power are now perfected up to 1,000

and more horse power in single units and a company of individuals organized for the manufacture of this superior and cleanly fuel, can control the entire power of its locality as well as all its fuel.

While accomplishing these desirable results, whereby cities will become clean and free from destructive smoke, an opportunity is afforded for the most profitable use of local capital.

All through the middle portions of the United States bituminous coal slack and screenings can be purchased for from fifty cents to one dollar per ton, and by converting the same into a hard coal, will not add to its cost, inasmuch as the gas produced will more than pay for the conversion; hence, at a cost of about one dollar a ton, in such favored localities, this most desirable fuel can be produced and will sell at anthracite coal prices among the large number now using anthracite instead of bituminous coal. But when sold at a lower rate, its use will become universal and the profit to any company will be enormous, and which company or individual conducting the business, can absolutely control the fuel and power business of any town or city in which the works are located.

The nearest approach to this hard cleanly fuel that has ever been used aside from anthracite, has been coke, generally made in gas house retorts, and while all such fuel that is obtainable finds a ready market for domestic uses, it is still undesirable on account of its sponginess and greater bulk. Metallurgical, or bee-hive oven coke, is much dearer, but less bulky, and whenever used for domestic purposes has given excellent satisfaction, but that, on account of its high price, is prohibitive and a regular supply unattainable. Such coke is generally made of a coal much more expensive than is necessary under the new system of hard coal making.

The new system of converting soft into hard coals makes a fuel far more desirable than bee-hive metallurgical coke, inasmuch as all the life and pure carbon is retained, whereby the shrinkage is exceedingly small in converting soft into hard coal.

It comes from the ovens in large blocks, like anthracite when it is mined, and has to be crushed for domestic use in the same way that anthracite coal is treated, which gives what is known as Pea Coal, Chestnut, Nut, Egg and steam boat sizes. In other words, when crushed and screened, these are the commercial sizes of anthracite coal, and the same names will apply in the manufactured article. Had such a system been known during the last fifty years, but a small amount of anthracite coal would have been mined, and there would be no fears of a scarcity of that local product produced by nature, because that produced artificially is far better for domestic and steam purposes and burns with a flame equally smokeless and with great effect, both for domestic, steam and metallurgical purposes.

Plants are designed of any size to suit any given locality, to produce from ten tons per day to 100 and more in a single battery of ovens. In New York City plans are now being prepared for the erection of converters sufficient to produce 8,000 tons of hard coal each

24 hours, and that will not begin to supply the demand, when put into proper sizes for the various uses for which the same is needed.

The best quality of bituminous coal suitable for the production of the very best metallurgical coke, is offered in New York, on long time contract, for $2.50 per long ton, and a second grade quality suitable for domestic purposes at $2 per ton. In converting this coal into coke as good and hard as Pennsylvania anthracite coal, the shrinkage will not exceed twenty per cent., while with some kinds of coal not over ten to fifteen per cent. Therefore, at the highest estimate, the cost will not exceed $3 for sufficient coal of the best quality to produce a ton of "Lowe anthracite," which will command for all purposes, an average of not less than $5 per ton, while 10 cents per ton will pay every cost of production.

The extra high heats, which are only obtainable by the Lowe system of hard coal making, are responsible for the very superior quality of the product, both of coke and gas. These high heats cause the heavy volatile carbon (which in poorer coke making methods goes off in tar), in this new apparatus, to be deposited in hard crystal form on the coke, making it much harder than what is known as coke made in the ordinary way, and containing more combustible matter, which entitles it to the name "anthracite coal," which it most resembles.

In making 8,000 tons of Lowe anthracite, fully 100,000,000 cubic feet of combustible gas is saved, each cubic foot of which will contain 500 heat units; and when carburreted to 20 candle power (which is accomplished in the same apparatus and under the same heats) will reach about 700 heat units. This gaseous product is far more valuable than the solid, and can readily be sold to existing gas companies, or converted into power, or distributed to consumers at a low cost and large profits for light, heat and power, in its natural state. This gas, without further carburretting, will produce about 20 candle power per cubic foot of gas, with the best incandescent burners; and is equally good for heating, cooking and power purposes; consequently when this system is put into general use, will rapidly take the place of the more expensive high candle power gas. But it is optional with gas companies, in making or purchasing this gas, to receive it in either form, to suit conditions at the time.

Where the hard coal products of the system are used, any open grate or stove suitable for the use of either bituminous or ordinary anthracite coal, will operate still better when the new fuel is employed. In house heaters, ranges and base burning stoves, it will give greater satisfaction than natural anthracite, as it will respond quicker to increased draught, and will as quickly lie dormant in an incandescent state, when the draught is closed off.

For steam purposes it has no superior.

The "smoke nuisance" can only be overcome when a steady supply of a better and less expensive fuel can be had. No amount of laws and city ordinances can cure this evil, but Lowe anthracite will do it, without an effort on the part of the law maker.

One of the greatest demands for this cleanly fuel will come from

the steam railroads of the country. It is well known that at present, locomotives waste more fuel than any other steam generator, and especially so when soft or bituminous coal is used; and it has been found that the coke produced from a ton of such coal is worth more to a locomotive boiler than when the full ton is fed to the boiler in its raw state.

There are more reasons than one for this. In the first place, when the coal is first shoveled into the fire box, the volatile or gas-making part of the coal is quickly thrown off through the smoke stack, and the sudden evaporation of these volatile portions so cools down the furnace at each charge that the atmosphere admitted for combustion cannot properly mingle with the gas, and both being too cool to admit of good combustion, the result is the enormous volumes of black smoke seen rolling out of the stack at each new charge of coal.

Not only is this valuable portion of the coal entirely wasted, and the surrounding atmosphere vitiated, to the discomfort of the passengers on the train, as well as the neighborhood through which it passes, but the tubes of the boilers become quickly coated with soot which forms a non-conductor of heat, which prevents the better portion of fuel from being properly utilized. Nor is this the only waste. The fireman, in his endeavor to keep up steam, has to frequently stir the coal to prevent caking, and each time this is done large volumes of cold air rush in through the open doors with its chilling effect. During this stirring operation much of the fine coal passes unburned between the grate bars into the ash pit, and is there entirely wasted; and again at least four times the amount of labor is expended when raw coal is used than would be the case with clean coke.

It is not a question whether or not railroads will use coke—that has been demonstrated long ago by the fact that they now use anthracite coal (when it can be had) at about double the cost per ton of bituminous coal, and coke is now used in many places, and recently has been adopted on some Eastern roads. If it could be had by the exchange of the coal for coke which it would produce, every railroad in the land would gladly make the exchange, and in many instances would pay a good cash difference—which they could well afford to do. The new fuel, however, will prove far superior to the best coke as now generally made.

The first question that occurs to the gas engineer is—by what method can this vast amount of coke be produced for supplying railroads, and for smelting, manufacturing and domestic use, to take the place of soft coal?

This being settled by the fact that a perfect system now exists, the next question is—how can we profitably dispose of such vast volumes of gas as would be produced while supplying this enormous amount of coke? This question is equally easy to answer. Fix the prices that will give the best returns to the Gas Company, and fully ten times as much gas can be sold as at present for heating, cooking and lighting purposes, as all instead of the few would become users of gas in place of other fuels for domestic purposes. But this will be

the smallest part of the gas business, for metallurgy and other numerous manufacturing concerns will consume vast amounts. The greatest use, however, of all, will be for power purposes; but not through the generation of steam. Electric energy will soon take the place of all other powers; it is now fast taking the place of steam and small gas engines.

The cheapest power on earth (aside from that produced by water falls) with which to generate electric energy, is the large direct electrically connected gas engines, now being made in sizes from 500 to 1500 horse power, when run with gas at cost at points of production. One man will care for engines sufficient to produce 10,000 horsepower. A plant of sufficient size, located say near Philadelphia, could supply power to run all the street railways in New York, Baltimore and Washington, and take the place of every steam power plant within a hundred miles or more of the central station, and not to exceed the distance at which power is now being successfully transmitted in various parts of the world. But as every city will use large amounts of gas, power and coke, long distance delivery of electric power becomes unnecessary, as plants will be installed in each city, in order to supply the required amount of smokeless solid fuel.

In order to throw still more light upon this new subject, the following report upon the new Lowe system, written in the interests of a syndicate of capitalists, by Mr. L. E. Bryant, an eminent mining engineer and graduate of Heidleburg University, will prove interesting:

(Copy)

DANVILLE, KY., February 20, 1902.

D. H. Gilman, Esq., 71 Broadway, New York City.

DEAR SIR: Permit me to herein give you the results of my investigations of Prof. Lowe's new coke and gas making apparatus.

The oven is an adaptation of the horizontal type of oven, which has been in use for years and presents no radical changes, except the flues through the walls and the sheet steel casing. The construction of the oven seems to be unnecessarily massive and costly, for only fire brick is used—even in the backing of the walls between the ovens and above the arches where hard burned red brick is used in the Semet-Solvay and other similar high heat ovens.

The charging, leveling and drawing of the ovens is done in the usual manner in such ovens and presents no difficulties. The size of the ovens is larger by 100 per cent. than the Semet-Solvay or the Otto Hoffman ovens, but is not larger than the Thomas oven or the McLanahan oven.

That the oven will work as a coke producer, is unquestioned, and there is no doubt but that the coke will equal any coke made in Beehive ovens from the same coal; and, further, that the yield of coke will be increased in this oven from a given coal over the yield in a Beehive oven.

I do not question Prof. Lowe's statement on this point, for the

tightness of the oven will prevent any losses from the burning of the fixed carbon by air leaking in, and the heat of the oven and rapidity of the coking process will cause the breaking up of some of the volatile hydrocarbons and a deposit of some of the resulting carbon, on its upward passage, on the crystal faces of the coke, thus producing the much desired glaze which protects hot coke in the upper zone of a blast furnace.

Lastly, the mechanical discharging of the coke by the ram will prevent breakage of the coke to a considerable extent, thus decreasing the percentage of small coke and breeze.

There should be very little ash formed in this oven. The yield of coke from this oven should approximate very closely the theoretical percentage from any given coal, say within two or three per cent.

The coal gas expelled from the coking coal is taken care of in an entirely novel way, and probably herein lies the secret of the large yield of mixed coal and water gas. The ovens being connected through the walls, and the travel of the gas being across each oven to one end of the battery, or reversed at pleasure, makes a uniform grade of gas, as the whole apparatus acts as a mixer. The hot escaping gases are, if necessary, mixed with sufficient air to keep up the heat at several points in the travel, and this heat is given up to the checker work regenerators at the ends of the plant and to the water gas generators, after which the gas can be cleaned and stored.

The production of the water gas and the enriching of the whole mixture in one plant and operation is, so far as the writer knows, absolutely new, and is so simple that it bears all the elements of a successful mechanical operation.

The large yield of mixed coal and water gas is probably due, in part, to the almost total consumption of all the soot and dust carbon given off from the distilled hydrocarbons of the coal and condensed and caught on the walls of the ovens, in the flues and in the checker work. The unenriched gas is consequently low in illuminants, but of great value as a fuel or as a source of power.

Prof. Lowe reports hardly any tar saved and no deposit of carbon in the flues or checker work, which would indicate that this is largely the source of the carbon which goes into the water gas.

The cost of these ovens, as designed by Prof. Lowe, is really more than I think necessary. It will not be far from $1,500 per oven. If, however, the method of construction is changed, so as to permit the use of hard red brick in the foundation below the hollow tiles, and in the partition walls and above the arches, and the ovens only constructed of best fire brick, I think the ovens could be constructed for about $400 less, and that they would readily stand better on account of the greater strength of the hard brick.

The Semet-Solvay oven is the hottest of all the flue ovens, and red brick is used in its construction in the places mentioned.

The cost of the apparatus at each end of the battery for making the water gas and cleaning the entire output of gas, I am unable to give you, but from its very simple construction I should not think that

it was very expensive. As soon as the detail drawings are prepared, exact estimates can be given you.

The cost of operating these ovens is possibly slightly more when producing gas and coke than when producing coke alone. I should say that a manager, a bookkeeper, one man at the ram, one top man, and one man at each door and a coke boss; or two office men and five oven men, would take care of the day shift, and that five men at the ovens would take care of the night shift—twelve in all. I think that for the following wages, good men can be had in the Central States:

Manager, per diem	$ 6.00	
Bookkeeper, per diem	4.00	
Coke boss, per diem	3.35	
Four helpers, per diem	8.00	
Night shift, per diem	11.35	—$32.70

The cost of producing coke and gas from New River at Cincinnati, Ohio, in a plant of 12 ovens, using 120 tons of coal a day, would be about as follows:

Labor and management, per 24 hours	$ 32.70
Supplies, sundries and water	3.00
Fuel for ram	1.00
Interest, depreciation, repairs and sinking fund, 10 per cent on $75,000	20.00
120 tons coal at $2	240.00
Placing same in bins and laries	18.00
	$314.70

PRODUCTS.

Using 120 tons of coal, the ovens would yield 70 per cent of dry large furnace coke and 5 per cent of smalls and breeze, and 15,000 feet of gas for every ton of coal used.

At $4 a ton the 84 tons of furnace coke would be	$336.00
At $1 a ton the 6 tons of small coke would be	6.00
At 20c per thousand feet the unenriched gas is worth	360.00
	$702.00

By the addition of 2 gallons of crude petroleum per 1000 feet of gas, to the ovens as the gas is coming off, which petroleum would not cost over 6 per cent, or $108.00 for the 1,800,000 cubic feet of gas, all this gas can be enriched to 20 candle power and its value increased from 10 per cent to 15 per cent per thousand cubic feet.

No attempt is made by Prof. Lowe to save any of the tar or ammonia liquor left in this gas, his theory being that all the tar and ammonia are burned, the tar giving up its carbon to the water gas and the ammonia burning to free nitrogen and water, which is decomposed again. It is possible that later it will turn out that some little amount of these products can be saved.

From the above figures it will be seen that even when using a very expensive coal and paying rather high wages and allowing a round margin for other expenses, etc., the value of the coke made pays the cost of operation, leaving the gas free. My understanding is that this gas, when enriched to 20 candle power, has been sold as high as 35 cents a thousand feet to a gas company.

The cost of maintaining this oven should not exceed 33 per cent of the cost of maintaining the ordinary by-product ovens. There is no similarity of the wearing parts at all, and beyond the abrasive action of the ram or jamming of the coke, there can be no possible chance for more than ordinary deterioration from heat and friction of the gases, which with proper construction and materials in the body of the oven, should be a minimum.

The sheet steel box is a most excellent feature, as it prevents the leakage of air into the ovens and the consequent weakening of the gases.

The output of coke from the ovens will be found to equal the output of the best of the by-product ovens, and the output of gas far exceeds the output of any of them by reason of the manufacture of water gas from waste heat and carbon in the one operation.

It is true that the ordinary by-products, tar and ammonia, are sacrificed to produce this gas, but as the gas is more valuable and more rapidly marketed, the wisdom of the change is apparent.

There seems to be no question of the ability of gas plants or pipe lines to market their output at figures around 25 cents a thousand feet for fuel, and 35 cents a thousand feet for illuminating gas.

Manufacturing plants of many kinds prefer it to any other fuel, and when assured of a steady supply, can be induced to change and use the gas at once. Such industries as glass works, steel works, tool works and potteries are almost dependent on gas of one sort or another, and the increasing use of gas engines of large size for the generation of power and electricity, makes sure the certainty of a market for a low priced gas in any of our manufacturing centers.

I trust that I have covered the ground fully, but will be pleased to answer anything in my power that may occur to you.

Yours truly,

(Signed) L. E. BRYANT,
Mining Engineer

DANVILLE, KY., February 20, 1902

D. H. Gilman, Esq., 71 *Broadway, New York.*

DEAR SIR: In reference to the use of Elkhorn Coal in the Lowe gas making oven in the cities of the Central States, and especially along the Ohio and Mississippi rivers, I beg to say that I believe the plan to be one that will work out to an unqualified success. This coal is one of the purest coking coals in the United States, and the vein from which it is mined is the thickest undeveloped coking coal in Kentucky. It can be mined and put on cars at about 30 cents a ton.

If an independent road to the Ohio river was built, or a 3 mill

per mile rate secured from some of the existing lines, this coal could be put on barges in the Ohio river at 75 cents a ton, and delivered at Cincinnati and Louisville at 90 cents a ton, and at St. Louis, Hannibal, Memphis and intermediate cities and towns at $1 a ton. If a connection was made with one of the existing lines, this coal would take the same rate and find the same markets as the Chesapeake and Ohio coals or the Norfolk and Western coals. The analysis of this coal and coke is as follows:

	Coal.	Coke.
Hyg. moisture and water	2.53	1.08
Volatile comb. matter	32.45	.60
Fixed carbon	62.15	92.65
Ash	3.07	6.26
Sulphur	.564	.764

This is an analysis of the ten analyses on page 21 of Crandall & Hodge's Report on the Southeastern Kentucky Coal Fields.

This vein of coal ranges from 5 to 8 feet in thickness, and should yield in the Lowe ovens from 72 to 75 per cent of large coke and 2 percent of breeze. The yield of gas will be fully 15,000 feet per ton of coal, and the gas should be of higher candle power than that obtained from the Pacific Coast coals mentioned in the reports on the Lowe oven. I have figured the above results from the tables prepared by Mr. John Fulton as the result of his experiments on the action of similar coal in Semet-Solvay ovens.

In the Central States of Ohio, Indiana, Illinois, Missouri and Kentucky, there are many manufacturing cities where Lowe plants should pay very large returns. To illustrate, take the following list of such cities, and from the present available gas statistics, I am of the opinion that each of them would furnish a market for the products from the size plants indicated and set opposite them:

OHIO: 400,000 tons of coal, yearly.

	OVENS.	COKE.	VALUE.	GAS.	VALUE.	TOTAL.
Cincinnati	24	60,000	$ 240,000	1200 mil.	$ 240,000	$ 480,000
Cleveland	24	60,000	240,000	1200 mil.	240,000	480,000
Columbus	24	60,000	240,000	1200 mil.	240,000	480,000
Toledo	12	30,000	120,000	600 mil.	120,000	240,000
Dayton	12	30,000	120,000	600 mil.	120,000	240,000
Danesville	12	30,000	120,000	600 mil.	120,000	240,000
Akron	12	30,000	120,000	600 mil.	120,000	240,000
	120	300,000	$1,200,000	6 bil.	$1,200,000	$2,400,000

INDIANA: 200,000 tons of coal, yearly.

	OVENS.	COKE.	VALUE.	GAS.	VALUE.	TOTAL.
Indianapolis	24	60,000	$ 240,000	1200 mil.	$ 240,000	$ 480,000
Terre Haute	12	30,000	120,000	600 mil.	120,000	240,000
Anderson	12	30,000	120,000	600 mil.	120,000	240,000
Vincennes	12	30,000	120,000	600 mil.	120,000	240,000
	60	150,000	$600,000	3 bil.	$600,000	$1,200,000

ILLINOIS: 480,000 tons of coal, yearly.

	OVENS.	COKE.	VALUE.	GAS.	VALUE.	TOTAL.
Chicago	48	120,000	$ 480,000	2400 mil.	$ 480,000	$ 960,000
Peoria	12	30,000	120,000	600 mil.	120,000	240,000
La Salle	12	30,000	120,000	600 mil.	120,000	240,000
Springfield	12	30,000	120,000	600 mil.	120,000	240,000
Bloomington	12	30,000	120,000	600 mil.	120,000	240,000
Decatur	12	30,000	120,000	600 mil.	120,000	240,000
Alton	12	30,000	120,000	600 mil.	120,000	240,000
E. St. Louis......	12	30,000	120,000	600 mil.	120,000	240,000
Cairo	12	30,000	120,000	600 mil.	120,000	240,000
	144	360,000	$1,440,000	7.2 bil.	$1,440,000	$2,880,000

MISSOURI: 360,000 tons of coal, yearly.

	OVENS.	COKE.	VALUE.	GAS.	VALUE.	TOTAL.
St. Louis.........	48	120,000	$ 480,000	2400 mil.	$ 480,000	$ 960,000
Hannibal	12	30,000	120,000	600 mil.	120,000	240,000
Kansas City......	24	60,000	240,000	1200 mil.	240,000	480,000
St. Joseph........	12	30,000	120,000	600 mil.	120,000	240,000
Joplin	12	30,000	120,000	600 mil.	120,000	240,000
	108	270,000	$1,080,000	5.4 bil.	$1,080,000	$2,160,000

KENTUCKY: 160,000 tons of coal, yearly.

	OVENS.	COKE.	VALUE.	GAS.	VALUE.	TOTAL.
Louisville	24	60,000	$ 240,000	1200 mil.	$ 240,000	$ 480,000
Covington	12	30,000	120,000	600 mil.	120,000	240,000
Lexington	12	30,000	120,000	600 mil.	120,000	240,000
	48	120,000	$480,000	2.4 bil.	$480,000	$960,000

In these cities the coke could be sold either for a foundry or furnace coke without further preparation at the price of the best Connelsville or Virginia coke. It could be crushed to anthracite sizes and sold for domestic purposes, for which use it is as good a fuel as anthracite, and can be sold from $1 to $2 a ton cheaper and still net the ovens handsome profit.

The gas can be enriched to 20 candle power, and sold direct for illuminating or to the existing gas companies at prices at which, under present methods of production, they cannot equal. Also the gas can be sold to all manner of manufacturing plants outside of those specially needing it. At 25 cents a thousand cubic feet gas is cheaper than coal to use under boilers in any of the cities mentioned, and with the advent of stricter smoke laws, will run coal out entirely if it can be had at low prices.

The most promising field, outside of the uses already mentioned, is the rapid introduction of large power gas engines, direct connected to electric generators, for developing electricity without the use of boilers. Such plants are very economical and are being introduced daily.

In the above mentioned states, there are a great many towns and cities of from 5,000 to 30,000 inhabitants, where gas, electric light, street railway companies and water works could be consolidated, and all run from one central power plant, where the Lowe process could

be used to produce gas and coke and electric power and also illuminating gas. The coke could be sold to local foundries or broken and screened to egg and nut sizes, and sold for burning in anthracite stoves and heaters at prices little below anthracite.

The gas from such plants which would be used for illuminating and power purposes would practically cost nothing, as the coke sold would pay the whole cost.

The figures now furnished by the makers of gas engines are so low that one hesitates to use them in a report, but there is unquestionably a great saving in using gas direct at 25 cents in a gas engine to generate electricity or power, over burning coal under a boiler and producing steam, which in turn is converted into power or electricity. In the former method, the boiler is entirely dispensed with and with it goes its great liability to accident.

I need not hesitate to say that in so far as its ability to produce gas is concerned, every Lowe plant would have a market and that the same industries that now seek the natural gas fields would gravitate to the cities where such plants were located.

Very truly,
(Signed) L. E. Bryant,
Mining Engineer.

Gas and electric companies are generally better equipped for putting into operation these improvements, as they already have a foundation on which to increase their stock or bonds, necessary to meet additional expenses of new construction, and those companies that accept and act upon these advance ideas will not only keep their present business, and add to the same with many fold their present profit, but from their works will practically run all the electric plants, street railways, steam railroads, and finally move all the wheels now operated by the expensive steam boiler, and for manufacturing purposes generally. Will gas companies "improve these shining hours?" or will they allow new companies to form and divide business—always leaving the slower party at a disadvantage? The writer thinks not, after their experience with the first introduction of water gas, of which this is the crowning work of the same inventor.

The impetus that cheap gas will give to the large gas engine industry cannot be overestimated, to say nothing of the enormous increase in all electric appliances that will so soon take place of steam and small gas engines. Also to the manufacture of all gas appliances for domestic use, and gas pipe for the supply of this great increase in gas consumption, as well as gas meters (a large proportion of the prepayment style for the poorer classes of people not now counted among gas consumers) and incandescent and other gas fixtures, for the thousands who never before used gas, etc., etc.

If the above were all theory, and each department had to be newly invented and combined, the reader might think the consummation of so grand a scheme was too far remote for present consideration, but each department is already perfected and only requires capital

for the combination on a broad basis to insure the grandest financial achievement of modern times, and the time for its full realization is now here; the engines and electric generators are ready; the process of separating gases in large volumes from bituminous coal is perfected, and the markets for the resulting coke are with us, and all users of steam for power are ready to dispense with it the moment they can get the far better electric power at no greater cost, and it can be furnished for much less and still afford enormous profits to the gas, coke and power producers. A perfect governor has been secured that will regulate gas to consumers from many pounds to as low a pressure as desired, thus reducing the cost of street mains 75 per cent. What a field this opens for the profitable use of capital everywhere!

Small gas and electric works, with business now too light for profitable operation, could, by supplying power and coke to surrounding towns, immediately add to their dividends many times its present profit.

Gas companies who install these improvements can sell power or gas for producing power to electric companies, and electric companies adopting these improvements can wholesale gas to gas companies at less than it now costs them to make gas, and while doing so can get their power at little or no cost.

Following we append extracts from letters and reports of a number of eminent engineers who have witnessed the operation of the first experimental plant. While this plant was sufficient to show the great advantages over all other systems, for the production of coke and gas, it necessarily was more or less imperfect, as the appropriation for the work was too meager to secure best results.

The following letter from one of the most eminent gas engineers in this country, Mr. Edward C. Jones, sets forth very clearly the advantages of the new system, and will be of interest to all gas and coke producing institutions of the country:

(Copy)

THE SAN FRANCISCO GAS AND ELECTRIC COMPANY.

Engineer's Department.

E. C. Jones, Engineer.

San Francisco, Cal., May 31st, 1901.

Hon. B. F. Tracy, 71 Broadway, New York—

Dear Sir: At the request of Prof. T. S. C. Lowe, I am pleased to give you my opinion of his new Coke and Gas Making System, from my observations and tests during the operation of the plant. Prof. Lowe's reputation as a successful inventor, and the fact that he is the "Father of Water Gas," would tend to make the gas world accept his latest invention without the usual amount of mistrust which applies to all new processes; in examining his process I have not, however, allowed these facts, nor his enthusiasm, to disarm my judgment.

As you know, the San Francisco Coke & Gas Co. has erected a small plant in our city. This plant consists of four ovens with a capacity of four tons each, together with the superheaters, steam generators, etc., and was completed and fired up a few weeks ago.

Since starting the apparatus, Prof. Lowe has been experimenting with the different coals available on the Coast and has produced an excellent quality of coke from inferior grades of coal in both 24 and 48 hours, with the use of only a portion of the gas for heating. The coke produced in 24 hours had the same appearance and seemed to be of as good a quality as that produced in 48 hours, from the same coal. The process is very elastic in its operation, and the apparatus is simple and easy to manage. Coke is made in the ovens by radiated heat and any outgoing heat is taken up by superheaters with checker brick and by steam generators for converting water directly into steam, so that there is a great conservation of heat in the machine.

Besides the separation and recovery of a large portion of the coal gas generated, water gas can be made in the machine at the same time and oil of any gravity may be used for making oil gas, or for enriching. The oil may be used in any of the ovens, and is converted into gas directly over the beds of coal, so that any heavy oil or asphaltum falls on the coal, and is made into coke. The fixing of the oil gas is done in the superheaters.

The plant has been laboring under a serious handicap on account of the use of local fire brick for building the arches over the ovens, as these brick have proved unsuitable for use in furnaces where such high heats are employed. The result has been that the arches soon showed the effects of the heat and the ovens were not operated at a heat necessary to produce 24-hour coke continuously. Notwithstanding the bad brick and the consequent low heats the plant has demonstrated that the process possesses unusual merit. It has produced a good quality of coke and at the same time has made a gas of 20 candle power (enriched with crude oil) and containing over 600 B. T. U. per cubic foot. I feel sure that with this process at least one-half of the gas contained in the coal will be recovered for sale.

Another feature of the ovens is the facility with which they reheat after a run of gas making and their ready adaptibility to all conditions in both coke and gas making.

I have made analyses and candle power tests of the gas, and they have demonstrated the ability to make good and satisfactory gas with this process, also that the coal gas of low candle power has a high heating value, as shown by the following analysis of coal gas of almost no luminosity.

May 12th, 1901, 10:30 A. M., using some steam unenriched coal gas (purified by lime):

Carbonic acid	0.0
Illuminants	1.2
Oxygen	2.4
Carbonic oxide	9.0
Hydrogen	50.3
Marsh gas	27.7
Nitrogen	9.4
	100.0

This gas contained 521 B. T. U. per cubic foot.

Following is an analysis of commercial gas of 22 candle power, made by the Lowe coke ovens; gas enriched with Bakersfield crude petroleum 15 degrees B., purified by lime.

May 12th, 1901, 10:53 A. M.

Carbonic acid	0.0
Illuminants	11.2
Oxygen	0.4
Carbonic oxide	3.4
Hydrogen	40.4
Marsh gas	41.8
Nitrogen	2.8
	100.0

This gas contains 787 B. T. U. per cubic foot.

The San Francisco Coke & Gas Co. has a contract with the San Francisco Gas & Electric Co. whereby the latter company takes the gas it manufactures. The gas to be of an even 20 candle power, containing at least 600 British thermal units per cubic foot, and free from stipulated impurities.

Under this contract the Coke company has delivered gas at intervals as we could spare a holder for measuring it, as the Coke company has only a very small holder and a proportional gas meter, but is about to erect a holder and meter sufficiently large for the work, when gas will be delivered continuously. The gas delivered met the requirements in every way. Following the completion of the preliminary experiments, the plant has been shut down in order to rebuild the arches and make a few needed additions.

Very respectfully,

(Signed) E. C. JONES.

The following letters from Mr. A. H. Branch, an experienced and well known gas and coke engineer of Denver, Colorado, will be of special interest as the results obtained under his observation was when the apparatus was in its worst condition. Much better results have been obtained in later operations:

(Copy)

SAN FRANCISCO, Cal., May 27th, 1901.

Prof. T. S. C. Lowe, City—

MY DEAR SIR: I arrived in the city May 21st, from Denver, Colorado, for the purpose of making a most thorough examination of your combined coke and gas making plant—since which time you have afforded me every facility possible for making the investigation, and as you have requested it, I herewith give you the result of my observations, together with my opinions as to the merits of your system.

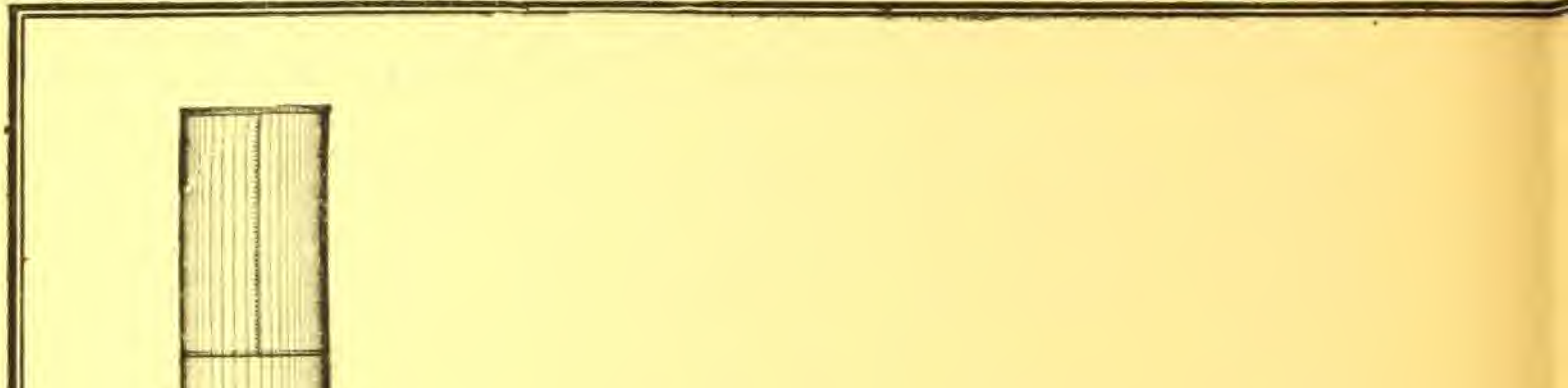
I find the apparatus works perfectly, for the production simultaneously of both coke and gas, and that the coke produced is of ex-

cellent quality and yields a higher percentage than by any other known system; the reason for this being due to the higher heats that can be so easily maintained in your ovens, causing considerable of the volatile carbon to attach itself to the coke, as it is made, while the gases arise until the entire mass is thoroughly coked to the bottom of the ovens, which I find can easily be done in 24 hours, and I believe by the heats which you are able to maintain, that when a better quality of fire brick is placed in the arches of the ovens, an equally good coke can be produced in 12 to 16 hours.

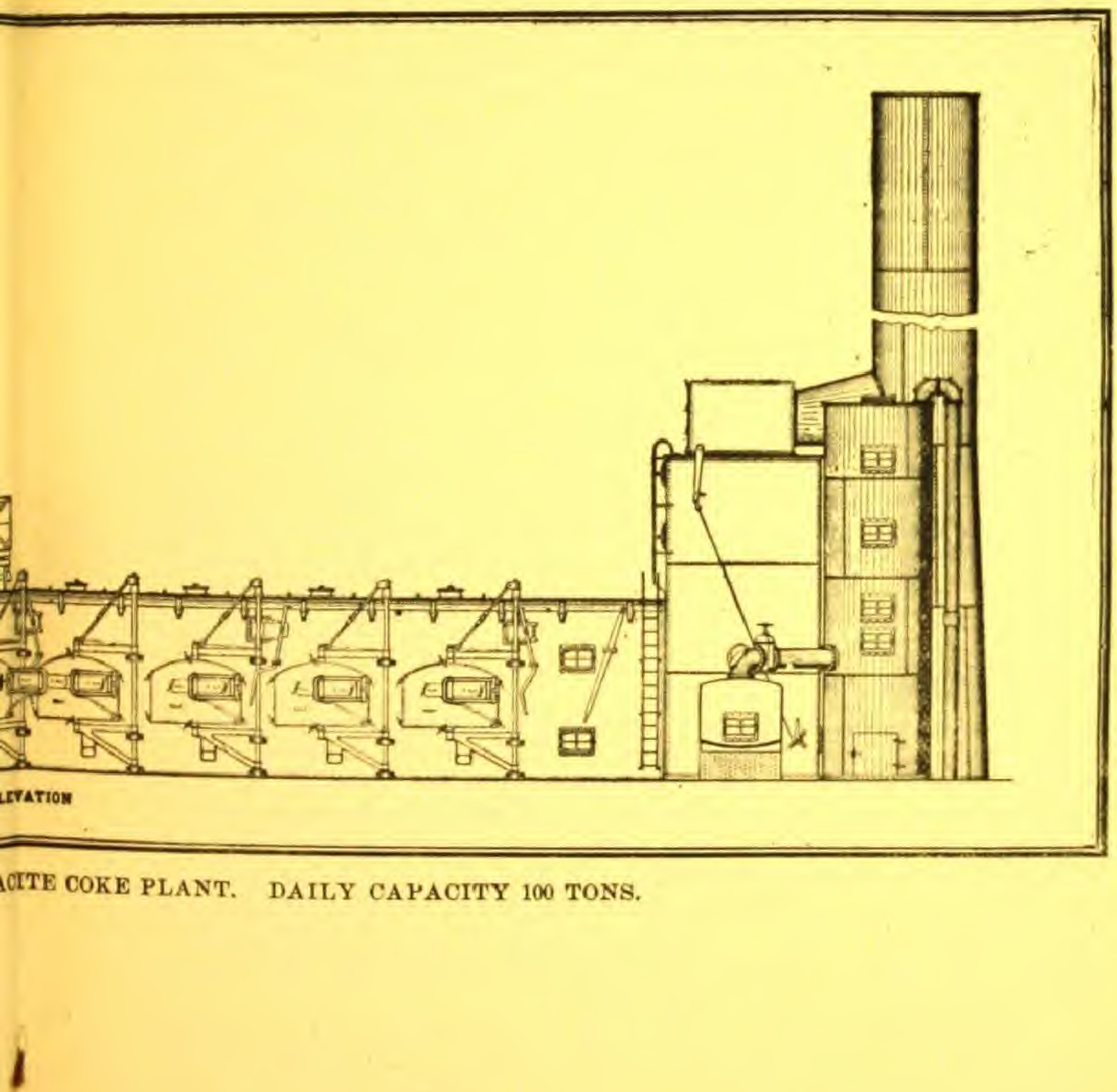
I have examined the coal from a number of the Pacific Coast mines and am thoroughly convinced that by proper washing of the slack coal, and removing the dirt, slate and other impurities, as is done in other localities, that the coke will be equal to any of our Eastern coke for blast furnace purposes, which requires the hardest quality of coke.

The charge of coke drawn from one of the ovens, made from Comax slack coal, yielded of hot coke and entirely free from moisture, 74 per cent of coke. Another mine (South Prairie) produced an extremely hard coke, yielding 83 per cent, and the superintendent showed me records of another mine which produced nearly 90 per cent of coke, and still with the small amount of volatile matter in that coal, the heats by this system were sufficient to do coking in same in 24 hours. All of the coal which I saw charged into the ovens, and which produced these large percentages of coke, is what is used for steam making purposes, there not being any of what is known as gas coal in the ovens during my observations.

Yesterday, the 26th, I made careful tests of the gas produced from these coals. During the last few days there has been charged into the ovens each 24 hours, at different intervals, a total of 12,000 pounds of slack or steam coal. As in the case of charging coal into retorts the largest amount of gas for a given time is thrown off during the first hour after charging, the observation which I made, the gas was taken off and measured three hours after the last charge was put into the ovens, and the heating up of the ovens was suspended one and a half hours before beginning to make the test of quantity and quality of gas, which places the operation of the plant under the most unfavorable conditions that can ever exist in practice. The results were that by the most careful measurement of the gas produced, the yield was steady throughout the observations, at the rate of 70,486 cubic feet per 24 hours, and it is certain that with the methods of operation whereby the heat is never suspended more than thirty minutes while the gas is being taken off, a much larger yield will be secured, and with the full sized battery of ovens, as is contemplated in your plan, I am convinced that one-third of the time will be sufficient for keeping the heat uniform, while the gas can be taken off and saved two-thirds of the time, in which case you must certainly save two-thirds of all the gas that the coal will produce, using the other one-third for keeping up the heats. Under these conditions, allowing that the coal was no better than what I saw treated in the ovens, the yield per ton would



SKELETON ELEVATION OF A LOWE ANTHRACI



ACITE COKE PLANT. DAILY CAPACITY 100 TONS.

be 11,743 cubic feet, and by adding the water gas (which was omitted in this case) the yield of combined coal and water gas would be much greater, and if gas coal were used instead of this coal with low volatile matter, the candle power must be far greater than the gas from the coal which I saw used. The gas which was produced during my observations measured, by careful photometric tests, 13 candle power without any enricher except what came from the coal itself. We afterwards added one gallon of enricher per 1,000 cubic feet, when the candle power at once showed 18 candles; therefore it would take less than one and one-half gallons to raise the candle power to 20, even with this poor quality of coal, and I believe that with a good quality of gas coal, the gas taken therefrom, would require not more than one gallon per 1,000 cubic feet to bring it up to 20 candles, *which, in this apparatus, is done at the same moment and under the same heats, and in the same apparatus in which the coal gas is given off;* thus, while securing large volumes of gas, the same apparatus yields an excellent quality of metallurgical coke, the profits on which should in most localities in this country, cover the entire cost of running the plant, giving the gas practically free of cost, and under favorable conditions and localities, even a profit on the coke with the gas free.

From my observations of the heats necessary to do this work, with the proper kind of fire brick used in building the ovens, there would hardly be any limit to the time at which the plant can run without stopping for renewals or repairs. I have carefully examined the Scotch fire brick used in constructing a portion of these ovens, which have been in constant use for three months, and while they are not considered as good as Eastern fire brick, they do not appear to be affected by the heats that produced the 24-hour coke, but, unfortunately, the California fire brick that was used in part for want of sufficient Scotch brick of proper shape for the arches, caused a loosening of the arches by the disintegration and cracking of the local brick, which makes it necessary for you to rebuild the arches, and which, when done with the brick that you have shown me, will make the ovens permanent and lasting.

I will say here that the heats required in producing even a 12-hour coke would not be as high as is carried in the open hearth steel furnaces, which, with their far greater heats, last for years. I mention this that there shall be no misapprehension as to the lasting qualities whenever the proper kinds of fire brick are used in constructing the ovens and superheating chambers.

The appliances which you have placed in each end of the row of ovens for increasing the volume of gas, by the use of the cheap native oils, work to perfection, producing a fine, rich, permanent gas without checking the coking process.

In conclusion, will state that while this method of making the bulk of the gas costs more than would be the case when the bulk of the gas is obtained from the coking coals by adding more ovens, still at the price that oil sells for in this locality (less than 2 cents per gal-

lon) the gas will cost less than one-half of that produced by the cheapest methods on the Pacific coast.

Thanking you for the courtesies that you have extended to me in the examination of your experimental plant, I am,

Yours very truly,

(Signed) A. H. BRANCH.

Denver, Colo.

Mr. Willard R. Green, Chicago, Ill.—

Have just wired you as follows: "There is no question about the success of Lowe's plant—particulars by letter today." I arrived in S. F. 5-21 and left 5-28. Was afforded every opportunity that was possible, to get at the bottom of facts regarding the construction and operating of Prof. Lowe's new gas process, and after the tests made, I am fully satisfied that the process will revolutionize the gas business of this country, also be a strong competitor in most sections in the coke making business.

5-23, A. M., 5,998 pounds of Comax slack coal was charged into oven No. 2. This oven was drawn 5-24 at 9 A. M., and yielded 5,032 pounds of hard steel coke, suitable for smelter or blast furnace purposes, yield being 84 per cent—just water enough was used to quench the fire.

5-24, 9:10 A. M., same oven was charged with South Prairie slack, 6,080 pounds being used. 5-25, 9 A. M., this oven was drawn and just enough water was used to quench fire so men could handle the coke with iron forks and wheelbarrows, and weighed out 4,593 pounds of coke suitable for smelter or blast furnace work—yield 75 per cent; after being weighed more water had to be put on to extinguish the remaining fire—probably 200 pounds or more. We tried this to get the make down to what is known as a hot coke.

Both the above coals were dirty slacks and are used for steam purposes in San Francisco—the better grades of above coals are used by the S. F. gas companies for making coal gas.

PRICES OF COAL IN S. F.

Comax and S. Prairie slacks, 2,000 pounds	$3.50
Comax and S. Prairie lump, 2,000 pounds	6.50

COKE PRICES IN S. F.

Gas house, per 2,000 pounds	$ 8.00
Lowe's coke, per 2,000 pounds	10.00
English imported, 2,000 pounds	13.00
Comax, from British Columbia, per 2,000 pounds	8.50

If the coal used by the Lowe plant had been washed and the dirt eliminated, the ash would have been reduced from probably (no test made on ash) 15 per cent to 7 per cent or 8 per cent.

The Lowe plant has no trouble in selling its coke at $10.00 per ton with all its ash.

Cannot think of anything more at this time, except to include an analysis of the combined coal and water gas that was made on Saturday, the 25th inst., and sold to the San Francisco Gas Company:

Carbonic acid	0.0
Illuminants	6.4
Oxygen	1.2
Carbonic oxide	5.0
Hydrogen	45.2
Marsh gas	36.4
Nitrogen	5.8
	100.0

Candle power, 20.4.
B. T. U. per cubic foot, 676.

Hoping that the above will be the information that you desire, I am, Very truly,

(Signed) A. H. Branch.

San Francisco, Cal., June 1st, 1901.

Prof. T. S. C. Lowe, San Francisco, Cal.

Dear Sir: I have read with much interest the letters written to you on May 27th by Mr. A. H. Branch of Denver, Colorado, and that of Mr. E. C. Jones, engineer in chief of the San Francisco Gas and Electric company of May 31st, to Hon. B. F. Tracy, of New York, and having participated in all of the operations of the preliminary plant of the San Francisco Coke & Gas Co., and having carefully noted the results in both coke and gas, I fully concur in all their statements concerning your admirable system for simultaneously producing a brilliant gas and superior "foundry coke" within the same apparatus. I have also noted carefully the production of gas by the use of our native heavy petroleum of 14 degrees B., and find by your new system that six gallons per 1,000 cubic feet will produce a very superior twenty candle gas containing very high heat units, exclusive of the coal gas.

Of the oil used, about 80 per cent is converted directly into a very permanent fixed gas, besides adding something to the coke in the

ovens, while about 20 per cent is returned in the form of tar, which at present rates sells for nearly three times the price of oil. The oil sells here at something less than 2 cents a gallon, and by taking the value of the by-product, leaves a cost of all the materials for making the gas at about 8 cts. per thousand cubic feet. The labor of two men on a shift of twelve hours is sufficient to produce one million cubic feet per day. This gas is independent of that produced from coal, which in this apparatus is very small in comparison with the whole gas making capacity of this plant when the native oils are used.

I have carefully noted the coke productions of your ovens, and find the yield to be the highest of any system I have ever heard of. Careful tests of a number of our Pacific Coast coals showed the following results:

Kind of Coal.	Amount of Coal Used.	Amount of Coke Returned.	Percentage of Coke.
Wellington scrngs. .	6,000 lbs.	5,620 lbs.	93.00%
South Prairie	5,932 lbs.	4,998 lbs.	84.25%
Wilkinson	6,080 lbs.	4,593 lbs. dry	75.74%
Comax scrngs.	6,000 lbs.	5,040 lbs.	84.00%

I think, as you do, that an allowance of about 5 per cent should be made for moisture in some of these cokes, as our methods of quenching are not yet quite perfect, but the coke from the most inferior coal and quenched as we do it, is readily taken at $10.00 per ton, and the buyer does his own loading and hauling.

Mr. Branch and myself carefully weighed a charge of the Comax coal and coke from one oven hot and free from moisture, and found the yield to be over 74 per cent of very hard coke.

While I know nothing personally of the yield in Beehive ovens, I have frequently been told by those who should know, that Comax coal yields between 60 and 65 per cent, and I believe this to be reliable.

Very truly yours,

(Signed) J. W. BURKHART, Supt.

The following letter from Mr. Frank C. Tryon, an experienced and well known engineer of New York, will prove of special interest, as he has given the subject close study and observation:

June 11th, 1901.

Hon. B. F. Tracey, President U. S. Coke & Gas Co., 71 Broadway, New York City.

DEAR SIR: Copies of the reports of E. C. Jones, chief engineer of the San Francisco, Cal., Gas & Electric Co., and A. H. Branch, chief engineer of Denver, Colo., Gas Co., have been submitted to me and, I presume, probably for the reason that I have been asked by you to go to San Francisco as an expert. Both these men are known

to me as expert gas engineers, Mr. Jones perhaps more favorably by reason of past work of public nature in gas making interests. Mr. Branch's reputation is, however, equally high in his own city. The reports of these two engineers made at separate times and under different conditions, are much more convincing than any single report could possibly have been to you. Both reports show that the plant was not in the most favorable conditions for successful tests, but all tests made show advanced results over either ordinary gas or coke making, that it seems hard to realize that both are accomplished at one and the same operation, and with the same heats.

Usual gas making by retort process gives a result under best conditions of only 10,000 cubic feet gas per ton of coal (more often only 8,000 to 9,000 cubic feet) and a resultant coke of very inferior quality of only about 50 per cent of the coals used and of this amount from 40 to 50 per cent has to be utilized for keeping up heats, leaving only about 20 to 25 per cent for salable coke. Gas by this retort process is only about 600 B. T. U. value and about 16 candle power. The coke from retort gas has no value for blast furnace or smelting purposes, and is only used for cooking and heating, selling usually for about $3.00 per ton delivered, netting the producer about $2.50 per ton.

The making of coke of a quality which is necessary for furnace or smelting purposes, is an industry entirely by itself in which no attempt is made to save any more of the gas than is required as heat to coke the coals, all the remainder being allowed to escape into the atmosphere; even in this manner the results are about 60 to 65 per cent of the coals returned in coke, and of this amount only about 50 per cent is marketable for smelting purposes and all the contained heats of the furnace are lost in discharging the coke from the oven and refilling with coal.

When we compare Prof. Lowe's system with the above and find that by this system the results are far above either of the others, its value can hardly be computed.

Coals in New York, worth say $2.25 per ton, of far superior quality to any of those used in San Francisco for the test referred to, will return, in coke at least 70 per cent of the coals used. This would make the coke cost here $3.21 per ton. Connellsville coke sells in New York and vicinity at $5.50 per ton. This will leave a profit of $2.29 per ton to pay for labor and other expenses.

A 100-ton plant erected near here, would probably require two shifts of four men each, together with a superintendent or foreman. Such labor would cost not to exceed $25.00 per day, leaving a balance of $204.00 per day to charge against interest, depreciation and expense and gives you 1,000,000 feet of gas as a clear profit.

The above is certainly a conservative calculation, when the tests made by Mr. Branch at San Francisco shows that 5,998 pounds of Comax slack coal yielded 5,032 pounds of hard steel coke, suitable for smelter or blast furnace purposes, which is 84 per cent; and another test of 6,080 pounds of South Prairie slack yielded 4,593

pounds of hot coke, which is 75 per cent, it is certain with perfect ovens and washed coal, the calculation above is on the safe side.

When we consider the volume and the quality of the gas taken from these Western coals, which was 11,748 cubic feet per ton of 13 candle power, and 648 B. T. U., the gas proposition looms up as an immense possibility. With the present cost of gas making in this section of the country, there should be no trouble in disposing of the gas portions of the output for at least 25 cents per thousand cubic feet to existing gas companies, the purchaser to supply holder to receive it. This would reduce the expense of erecting plants, and contracts can easily be secured for the output to be accepted daily.

With coals which can be purchased here for $2.25 per ton, a gas of at least 18 candle power can be produced, and possibly of 20 candle power, which would probably be the standard required. If only 18 candle power has resulted, it could be brought to required 20 candle power at an expense of about one-third-gallon oil per thousand cubic feet.

If the gas from one hundred tons of coal was turned into power instead of illuminants, and utilized with modern high grade gas engines, it would supply 50,000 H. P. for one hour, or 5,000 H. P. for ten hours, or if again this power was turned back into illuminants by electricity, it would supply 55,000 16 candle power incandescent electric lights for ten hours. Or again, it would move 250 street cars, eight miles per hour, for ten hours, or 20,000 car-miles, and if each car contained 30 passengers, it would carry 7,500 passengers eight miles per hour for ten hours, or move 75,000 persons eight miles, or 600,000 persons one mile. This amount of power is derived from the gas from 100 tons of coal and the coke has shown a profit of over $200.00.

The gas from a plant, daily capacity of 1,800 tons coal, would supply all the power required by the Metropolitan Traction Co., including the Third Ave. and Huckleberry System, to run their entire road, and the profit on the coke, after paying for the coals and labor, would amount to over $3,600 per day, or if this coke was again turned into water gas, which could be done with the same heats, it would furnish over 15,000,000 feet additional gas per day.

The possibilities of this system are almost limitless, and it seems to me that whoever controls it holds the solution to many very important problems which must soon be solved. The absorption of heat by water to be expanded for power is a waste so great that it will soon be looked back upon with wonder, while the direct expansive power of gas, through the medium of the high grade gas engine, is the reliable power which will eventually move the commerce of the world.

There are many interesting problems to be worked out along the lines of the two able and interesting reports above mentioned.

Respectfully submitted,

(Signed) Frank C. Tryon.

Four months after these reports were made, the ovens were again fired up for making a special test in the interests of New York parties, and from the examination then made by Mr. Jones, the following letter was received from him, together with the results produced in the manufacture of coke by the old methods as compared with the yield with the same coals by the new Lowe process.

San Francisco, Cal., October 8th, 1901.

Prof. T. S. C. Lowe, Pasadena, Cal.

My Dear Prof. Lowe: In reply to your letter—I received the photographs of your coke system and remailed them to Mr. Wellman of Cleveland, Ohio.

I enclose a letter of introduction to him, and I know you will like him, as he is one of the leading engineers of the United States, and at present president of the American Society of Mechanical Engineers. I also enclose one of his circulars in regard to coke.

I quite agree with you that the time has gone by for conservative statements concerning your system of coke and gas making, and the results of your last test were so highly satisfactory that there is no question as to the merits and complete success of your system. One of the most gratifying features of the recent test was the large percentage of good coke produced in 24 hours and the large amount of coal gas of high heating value recovered from the ovens as a by-product. I should like to have you send me your Eastern address in both Philadelphia, New York and Boston, so that I may reach you by other letters while you are away. I assure you that I wish you all success and will do everything in my power to help you.

Sincerely yours,

(Signed) E. C. Jones.

P. S.—Coke produced from coals obtainable on the Pacific Coast in retorts for gas making purposes:

	Per Cent.
Hetton coal, Australia	64.00
Blue Canyon coal	60.00
Walsend coal, co-operative mine, Australia	65.00
South Prairie coal, Washington	63.75
Comax coal	66.6
Westport coal, New Zealand	65.00
East Greta coal, Australia	62.5

E. C. J.

The following extracts from an exhaustive report in the interests of New York and Seattle capitalists will prove of unusual interest, coming as they do from Mr. Chas. Russell Collins, engineer, of Seattle, Washington, a gentleman of unusual ability and extensive practice in both coal and water gas manufacture:

SEATTLE, Washington, Oct. 7, 1901.

J. W. Clise, Esq., Seattle, Wash.

DEAR SIR: The following is a general report of the test made by me of the Lowe coke oven process:

I left Seattle on August 22d, arriving at San Francisco on August 24th, on which day I met Professor Lowe, as previously arranged by telegram. The general plan of the operation was as follows:

1. *COKING*. Charges of uniform weight were made every six hours in one of the four ovens, each oven being drawn once in 24 hours.

2. *GAS MAKING*. Gas was made intermittently day and night, averaging 30 minutes out of every 60 minutes, except when drawing and charging ovens.

3. *HEATING*...The balance of the time, or every alternate 30 minutes, was used in heating the apparatus.

The arrangements for measuring the results were, in general, satisfactory. Pressure gauges were placed at all of the critical points of the apparatus and connections. All materials used were accurately measured by scales and meters.

The gas was measured in a proportional meter of the Westinghouse type, and its registration was checked by a set of four 150 light, dry meters. The latter were carefully proved before and immediately at the termination of this trial. All measurements of gas were corrected for temperature from the record of a thermometer set at the inlet of the battery of meters.

A bar photometer, 60 inches, equipped with wet test meter, candle balance, etc., was used in the tests of candle power and all readings were corrected for consumption of gas and sperm. The samples of gas were taken from all parts of the apparatus during the periods of gas making, and from the experimental holder. These samples were collected in glass tubes, the ends of which were hermetically sealed by fusing in a Bunsen flame.

Specific gravity determinations were made by the effusion method. While the apparatus was making gas, a pressure of 0.3 in ches to 0.5 inches was maintained. All gauges and meters were read by myself or my assistants at short intervals during each run of the entire test.

During the five days of continuous operation, coal was coked regularly and separate runs of gas from six to ten hours' duration each, were made of:

1. Straight coal gas.
2. Coal gas and non-luminous water gas.
3. Carburetted coal and water gas.

All readings, weighings, collections of samples and candle power tests, were attended to by my assistants or myself.

COKE.

South Prairie coal from the state of Washington was used. It is good coking coal, showing about the same analysis as that of the Cape Breton coal, used in the Otto-Hoffman plant at Everett, Mass.

Twenty thousand pounds, or 8.9 long tons, were charged and drawn each 24 hours. Each of the four ovens took its proportional weight of coal, the end ovens doing the same work as those in the center. The time of drawing the coke and recharging with coal averaged 20 minutes.

The coal was discharged from two hoppers through charging holes in the top of each oven, and afterwards spread and levelled by hand. Distillation of the coal commenced at once, the rising gases igniting immediately on closing the oven door. At the end of 24 hours, each charge averaging 4,000 pounds, was drawn in a solid mass on to a receiving car. A "drag" was used for this purpose. The coke at this point of the operation was of a uniform heat, and uniformly coked, except where it came in contact with the "drag." The depth of the charge averaged 18 inches. No exact analysis of the coke has been made, but physically it had all the well-known characteristics of a bee-hive product. The columnar structure, the crystallization of carbon on the upper portions and the cauliflower sides were well-defined.

South Prairie coal, under different methods, yields the following results in coke:

Method.	*Yield.*
Coal gas benches (regeneration)	65%
Bee-Hive	70%
Lowe	80%

The heats increased until the third day of the test, after which they remained constant without apparent change. During the whole test, gas was made intermittently, so that about 50 per cent of the total time was consumed in heating the ovens.

The separate charges varied from 74 to 88 per cent in the yield of coke. Under the high heats maintained, the condensable gaseous compounds of value were completely decomposed, resulting in the production of a higher percentage of coke and an extremely low yield of tar. As a further result of the high heats, the yield of gas per ton of coal was extremely high. At lower heats, more tar would be recovered; a richer gas would be made with a consequent decrease in the yield of coke.

The flexibility of the apparatus, in the manipulation and control of the air admitted for raising the heats, should make it possible to obtain any desired result in the quantity and quality of coke, gas and tar, between the extremes of maximum and minimum heats, which will not destroy the brick work.

No means were provided for the recovery and measurement of ammonia. It will probably be equal to one-half of the total product from a given coal, as gas is saved and stored for but one-half of the total time of coking.

COAL——GAS.

Although the scheme of the process does not contemplate the manufacture of straight coal-gas, alone, a trial of the apparatus was made at my suggestion, in order to determine the actual quantity made per ton of coal. This result enables more exact comparison possible with other forms of coking, or by-product processes.

Two days were spent in operating in this manner, with the following results:

	Cubic Feet.
Coal gas made per hour	7,093
Coal gas made per day	170,232
Coal gas made per ton (short)	17,000
Coal gas made per ton (long)	19,100
Surplus gas for sale	85,116
Heating gas for sale	85,116

This result gives a yield per ton of 2,000 pounds in surplus gas of 8,500 cubic feet per ton 2,240 pounds.

The high yield of gas per ton equal to 8.5 cubic feet per pound of coal, was due to the extremely high heats in the ovens and superheaters.

The heating value per cubic foot of the mixed gas is low, but the total heating value per ton is high, due to the increased make. It equals 5,162,953 B. T. U. per ton of 2,240 pounds.

(Note. This was in addition to the large yield of hard coke.)

CARBURETTED COAL AND WATER GAS.

Carburetted gas was made on the fourth day of the test. The only oil used was a California product from the Bakersfield district, having a gravity of 14 degrees Beaume. A continuous trial throughout one day gave the following results:

Gas made per hour, cubic feet	10,675
Gas made per day (23 hours), cubic feet	245,525
Gas made per ton (2,240 pounds), cubic feet	27,600
Oil, 14 degrees B., per 1,000 cubic feet (gallons)	6.27
Candle power	21.02
Candle power, corrected for CO_2	24.15
Candles per gallon	3.62

(Note. This gas was exclusive of that used to keep up the heats.)

Based on the above results, a 20 candle power gas can be made with 5.52 gallons per 1,000 cubic feet of 14 degrees B. oil.

The increased volume of gas as compared with the make of uncarburetted coal and water gas, is due to the increased production of lamp black from the oil, which dissociates an additional quantity of steam. The analysis discloses this fact. As a consequence of this decomposition of a portion of the oil, for the purpose of increasing the volume of gas, only a portion of the oil acts as an enricher.

The water gas is made at the expense of the hydro-carbons in the oil and coal gas, as the coke remains unaffected—the entire yield of 80 per cent being saved.

The candle power was varied purposely by varying the amount of oil per run, ranging from 28.2 candles to 14.00 candles. The apparatus made gas freely, and in greater quantity than the scrubbers, purifiers and exhauster could handle, properly. The gas of 22.0 candle power gave a flame of great effectiveness in a regular Bray burner, measuring 4 inches in height and 3¼ inches across the top, with a very small zone of "blue" at the tip. It was white and strong in spite of the high percentage of carbonic acid and nitrogen.

(Note. The undue amount of carbonic acid and nitrogen contained in some of the samples of gas analyzed was due to the neglect of the operator to discharge the products of combustion out of the stack before beginning his run of gas making, which is easily done, and especially so in the more complete apparatus as now designed.—Editor.)

GENERAL.

The following observations are the result of the foregoing experiences:

1. (a) The general plan of coking, closely follows the well-known principles of Bee-Hive practice, and the design of the apparatus in this respect is an adaptation of a successful oven of the Bee-Hive type.

(b) The intermittent operation of alternately heating and gas making had no appreciable effect on the quality or quantity of coke.

(c) The admission of air and the conditions governing the combustion of the products of distillation, are under absolute control, thus giving a flexibility to the apparatus as a coking oven, which should make it possible to coke low grade coals.

(d) It is, therefore, obvious that the yield in coke and tar may be varied by the adjustment of the heats.

(e) When making high grade, strong coke for cupola use, the yield of tar will be insignificant; hence the commercial value of the coke must be enhanced (1) by an increased yield per ton of coal, and (2) by increased value on account of superior quality, in order to offset the loss of tar as a residual.

2. (a) The analysis of the samples of gas prove the successful dissociation of steam in the presence of lamp black, producing non-luminous water-gas.

(b) The supply of lamp black may be provided from one or both of two resources:

From the decomposition of the condensable hydro-carbons in the *coal-gas*. From the decomposition of the condensable hydro-carbons in the *oil-gas*. Competitive conditions will govern the selection.

(c) The efficiency of the apparatus, in the enrichment of gas with oil, should be equal to that of any water-gas process operating intermittently.

(d) The apparatus readily admits of operation for the production of:

Blast gas,
Producer gas,
Coal gas—non-luminous; Coal and Water Gas, non-luminous.
Coal gas—carburetted; Coal and Water Gas, carburetted.

AND WITHOUT AFFECTING THE COKE PRODUCT.

In general, the construction is compact and simple, free from intricate flues, and well adapted to withstand the work of variable heats. The cost of construction and maintenance should be at a minimum for an apparatus of the by-product type.

(NOTE.—The discrepancies which appear in the foregoing reports as to the amount of oil required for carburetting the coke oven gas is more apparent than real. First, the gas from the coal, unmixed with water gas, requires but a small amount of enrichment. When the coal gas and water gas are in about equal proportions, the water gas portion requires as much enrichment as water gas does by any other process. In some of these tests a large portion of the gas was made entirely from oil, which accounts for the increased make of gas in some of the runs. This extra volume of gas from oils required the use of from four and a half to six gallons per 1,000 cubic ft., according to candle-power.)

In the operation of these experimental coke ovens which covered, all told, a period of five months, there was not a single hitch or stop, and none of the observers—including the inventor—could suggest any improvements in principle; and the improvement in construction was fully planned before these ovens were built. These improvements consist in heavier and better brick work, better iron and steel work, including better arranged valves and doors, and the substitution of discharging ram instead of the drag used, in these experiments, for discharging the coke, also larger steam generating surface at the ends of the oven.

In the experimental ovens, which were built on a very inadequate appropriation, an iron drag weighing a half ton to each oven, was used, which required twenty minutes to operate; whereby the ovens were exposed to the indraught of cold air, instead of three minutes when a discharging ram is employed. In addition to the extra cooling effects caused by the oven door being too long open, the cold iron drag in each case had a tendency to cool the bottom and absorb heat therefrom, which will not be the case in the better method of handling the coke.

Taking the time saved in restoring heats lost in this way, together with a great saving in radiated heat through the thinner brick walls, which is entirely saved in the present walls of double thickness with best non-conducting materials between the brick and iron work, the

time required to restore heats in the ovens will be reduced from *thirty* minutes to the hour, to *twenty* minutes, which will allow the saving of two-thirds of the gas from the coals, instead of one-half, as shown in the operation of the experimental ovens. This will secure a gain of 25 per cent in extra gas saved per ton of coal used. In consequence of shortening the time of charging and discharging the ovens, and by their more perfect construction, a depth of coal of 30 inches will be more perfectly coked than 24 inches in the same time in the experimental ovens, thus increasing their capacity or daily output 25 per cent.

While the gas is taken off from the ovens intermittently, the coking process is continuous, inasmuch as neither atmosphere used in restoring the heats or steam used in making water gas and taking away the coal and oil gases from the ovens, are either of them admitted at a less heat than is sufficient to keep the coking process going on rapidly.

Owing to the unusually even heats that are maintained in these ovens the liability to repairs is but a fraction of that of any other form of coke ovens.

RESULTS.

As an example of the profitableness to investors in the new Lowe Anthracite System, we will suppose that in a city of 15,000 population there would be about 3,000 families; and allowing that 2,000 families should average 20 tons of the new anthracite per annum, including what would be used for manufacturing purposes—including steam, foundry work, etc.—at say $3.00 per ton, would yield a gross income of $120,000.00 per annum. Deduct for raw materials (coal slack) $60,-000.00 per annum, and for labor $20,000.00, which would include delivery of the fuel (a very high estimate for both items of expense) and we then have a net profit of $40,000.00 per annum on an investment not to exceed $100,000.00. In addition to this profit may be added the total receipts for gas sold to the gas company, and for power and other purposes.

To licensees operating this system the parent company will furnish attractive illuminated posters for effectively advertising LOWE ANTHRACITE as the ideal fuel. This will cause quick trials of the fuel in any locality, and once tried, the user will have no other kind. Also a number of exceedingly attractive gas appliances for domestic use, will be sold at low wholesale prices to licensees, which will largely increase gas consumption.

Such a business as above could be capitalized at $500,000 and its securities would become the most popular of any in its locality, controlling as it would, one of the most important public utilities. There are many hundreds of moderate sized cities which would support a capitalization of from $100,000 to $1,000,000, besides the larger cities whose capitalization under this new system would reach from $1,000,-000 to many millions.

Where the raw materials can be had at a lower rate, then the Anthracite can be sold correspondingly low, and where bituminous coal is higher, it will always be found that a clean domestic fuel as desirable as LOWE-ANTHRACITE, commands a correspondingly high price.

About twenty-five years ago some enterprising owners of anthracite coal mines shipped their coal to some European cities for domestic uses, and on the decks of the same coal vessels they took along the American base-burning stoves and house heaters, in order to quickly introduce the new fuel. The venture proved successful. Now base-burning house heaters and stoves can be had everywhere, while the ordinary open grate and cooking ranges are well adapted to this new, hard and cleanly fuel without alteration.

In *operating the new Lowe System for the production of coke and gas, central locations can be selected, inasmuch as there are none of the disagreeable odors that are common to ordinary gas works attached to this system, whatever. The coke, when drawn from the ovens, is clean and smokeless, while none of the gaseous product which gives the odor can in any way escape, consequently this odor is all sold for cash at so much per thousand cubic feet, perfectly purified and, when used for lighting or domestic or other fuel purposes, is the sweetest, cleanest, and most healthful of all fuels.*

FOR BLAST FURNACES.

And other metallurgical uses, on account of its extra freedom from sulphur and the further fact that the coke is much harder and more suitable for carrying stock, and with it carries fully 10 per cent more pure carbon, LOWE ANTHRACITE COKE has no equal. The extra carbon comes from the volatile oils contained in the coal used, and on account of the extra high heats, is deposited in hard crystal form on the coke, instead of going off in tar or in unfixed carbon and wasted as is the case in all other methods. From the same cause a large portion of the sulphur is eliminated while heating the apparatus, and a still larger portion is taken up by the action of white hot steam, which is converted into a combustible gas carrying with it the sulphur, and in turn this sulphur is entirely eliminated from the gas by Prof. Lowe's new oxide method of purification, at a cost of less than 1 mill per thousand cubic feet.

IRON AND STEEL MILLS.

When producing their own coke will at the same time recover sufficient gas of high heat units to displace the usual gas producer plants, and their always attendant heavy expense, and at the same time do much quicker and better work.

Although this is the first printed announcement that has been issued since the tests of the System were made, there are now five batteries of the new Lowe Coke Ovens in as many places now under construction, on the Pacific Coast and in the East, besides many others in contemplation. A strong New York syndicate is now being formed for handling several of the Eastern States, particulars of the organization of which will be given in due time, describing territory to be covered.

To those who may wish to be early in the adoption of these improvements, special advantages will be given, and to those desirous of securing exclusive rights for special localities, or a state, for future development pending further investigation and knowledge of the system, options can be secured on advantageous terms, also options for rights in one or more foreign countries.

In the meantime, for additional information address American Coke and Gas Co., ~~374~~ Bourse Building, John Haug, Engineer, Philadelphia, Pa. 536

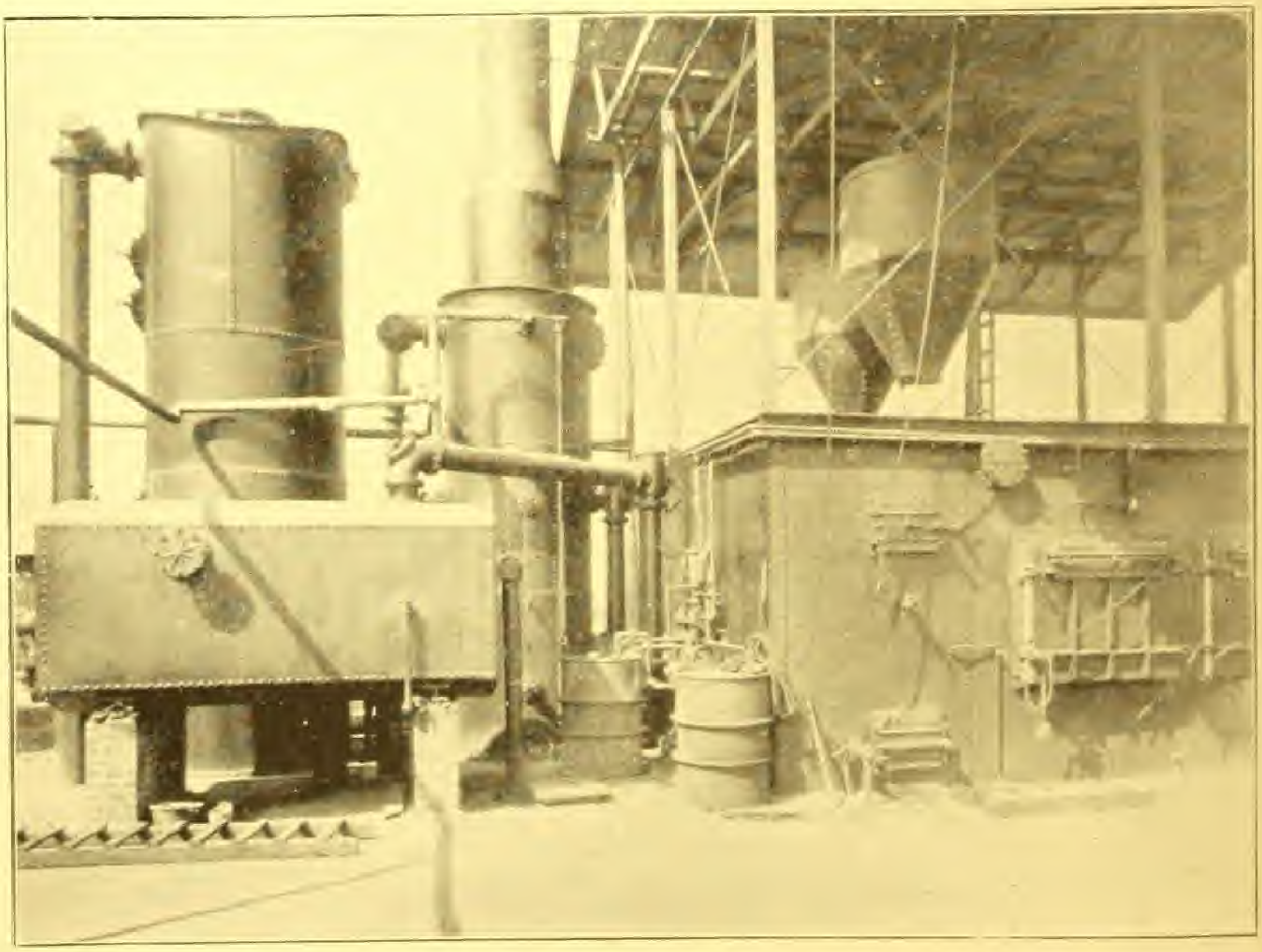
Pacific Coast office, Los Angeles Safe Deposit and Trust Co., Bradbury Building, Los Angeles, California.

MAY, 1902

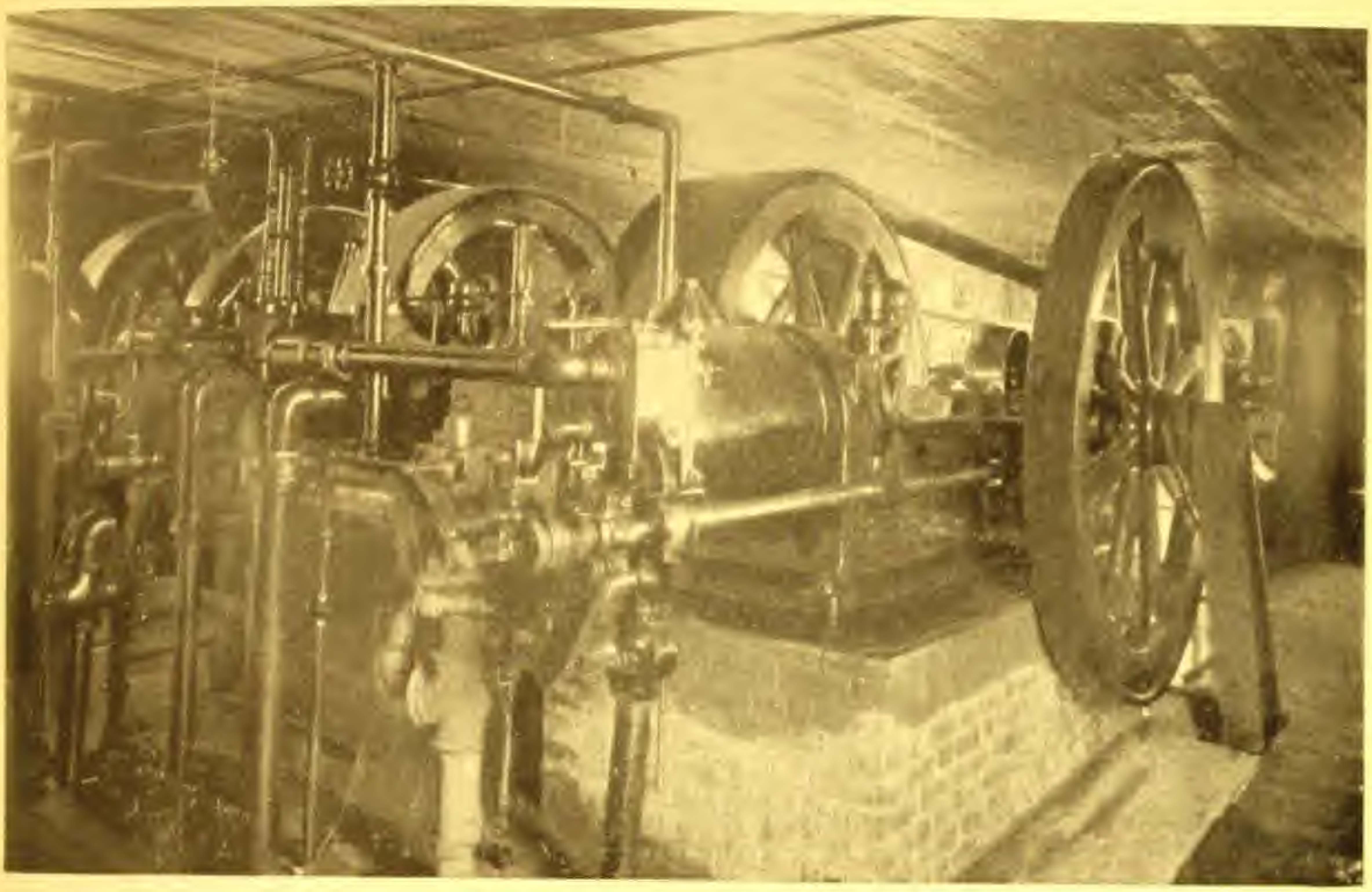
PROF. LOWE DIRECTING THE BRICK WORK IN THE CONSTRUCTION OF FIRST LOWE ANTHRACITE COKE OVENS.

FIRST BLOCK OF LOWE ANTHRACITE COKE DRAWN FROM EXPERIMENTAL OVENS AT SAN FRANCISCO, APRIL, 1901.

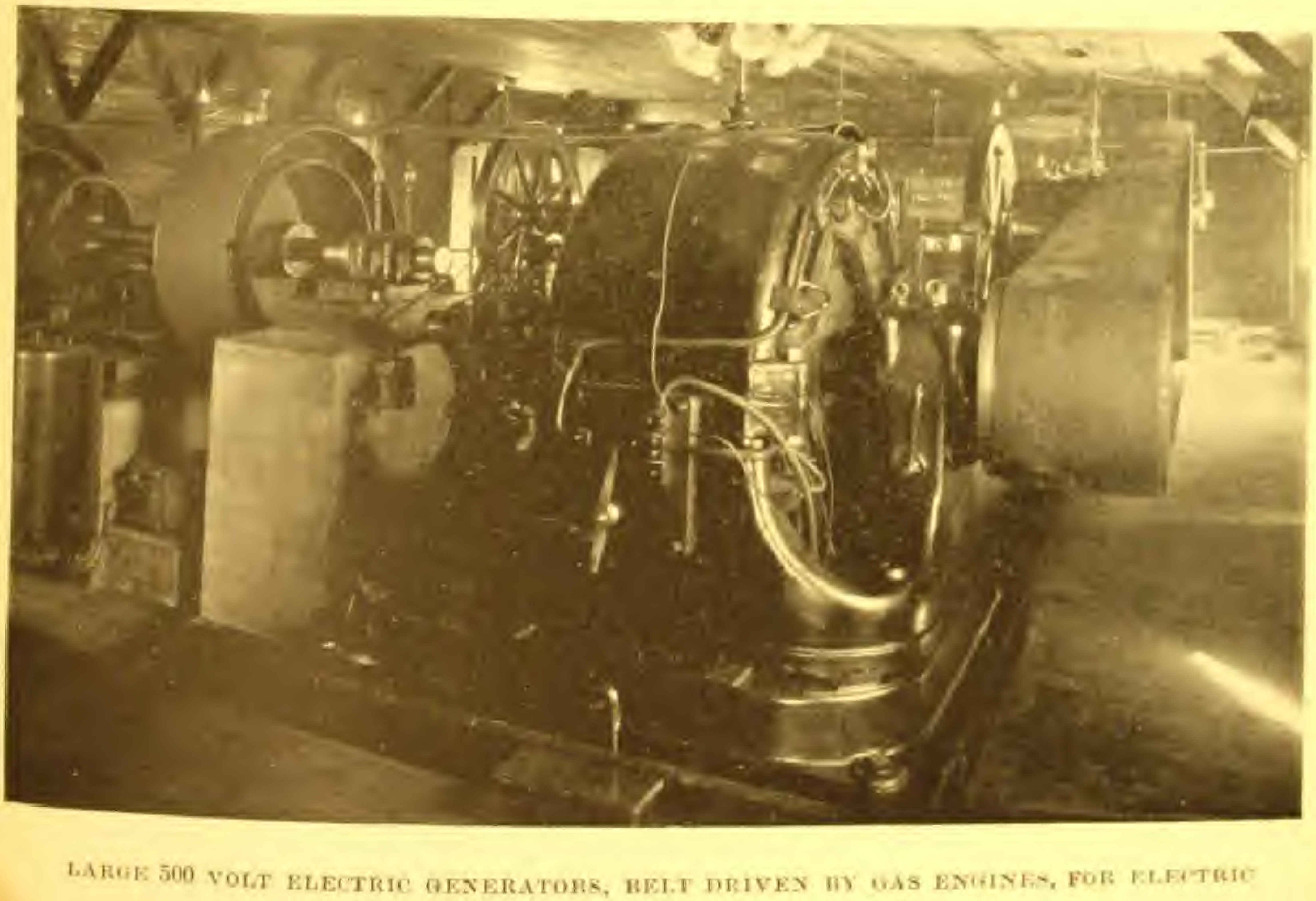
GENERAL VIEW OF EXPERIMENTAL LOWE ANTHRACITE COKE OVENS, AT SAN FRANCISCO.



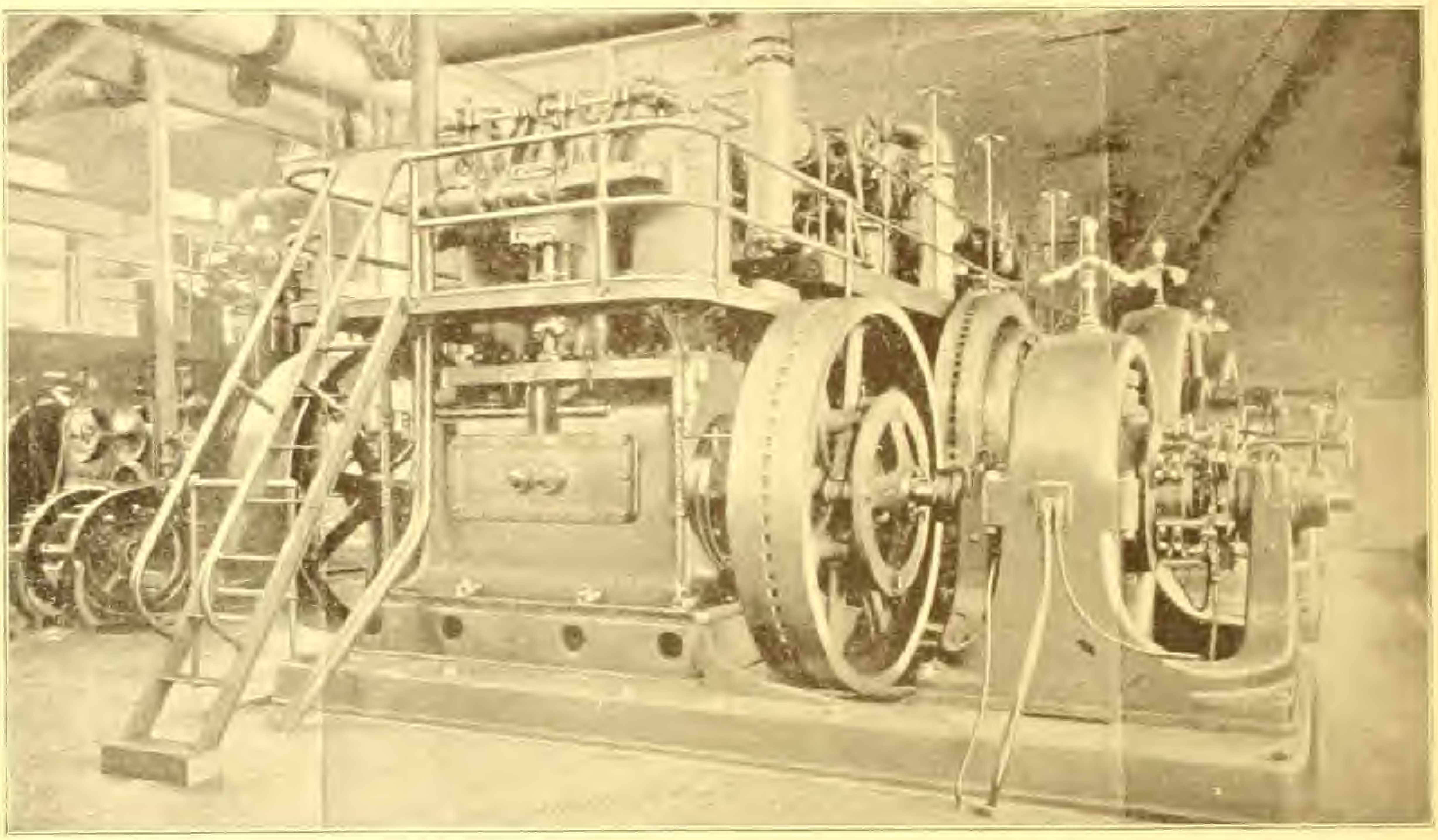
VIEW SHOWING WASHERS, SCRUBBER, STEAM GENERATOR AND THEIR CONNECTIONS WITH LOWE EXPERIMENTAL COKE OVENS, AT SAN FRANCISCO.



A GROUP OF GAS ENGINES OPERATING THE MOUNT LOWE ELECTRIC RAILWAY.



LARGE 500 VOLT ELECTRIC GENERATORS, BELT DRIVEN BY GAS ENGINES, FOR ELECTRIC STREET RAILWAYS.



12,000 HORSE POWER, CENTRAL STATION, OPERATED BY DIRECT CONNECTED GAS ENGINES FOR ELECTRIC LIGHT AND POWER PURPOSES.

ONE OF THE PROFITABLE WAYS OF USING THE SURPLUS GAS FROM THE LOWE COKE OVENS.

PROF. T. S. C. LOWE

Professor T. S. C. Lowe, inventor of the new "anthracite coke" and gas system is too well known to the gas fraternity of the world to need any further introduction, but as men have been born since his earlier inventions who are now grandfathers, and consequently fully two new generations have come into existence since he brought out several inventions of great importance to the world, the following sketch, quoted from the Christmas Number of the San Francisco Wasp, will prove of unusual interest in connection with his later inventions.

HEAT

LIGHT

POWER